Journal of the Kansas Entomological Society

(Central States Entomological Society)

Vol. 32 July, 1959 Number 3

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Entered as second-class matter June 7, 1939 at the Post Office at Manhattan, Kansas, under the Act of August 24, 1912.

JOURNAL OF THE KANSAS ENTOMOLOGICAL SOCIETY

A quarterly journal published in January, April, July, and October, devoted to Entomology in the Western Mississippi Basin and the proceedings of the Kansas Entomological Society.

Manuscripts for publication may be sent to the Acting Editor, George W. Byers, care of the Department of Entomology, University of Kansas, Lawrence, Kansas, or to any member of the publication committee.

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KANSAS ENTOMOLOGICAL SOCIETY

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Vol. 32, No. 3, July, 1959

This issue mailed July 1, 1959

Kansas Entomological Society
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A NEW SPECIES OF *ALCIPPUS* STAL FROM ECUADOR (Heteroptera: Pentatomidae)

HERBERT RUCKES[1]

In the Robert L. Usinger collection (University of California, Berkeley) was found a series of ten specimens of a new species of this interesting discocephaline genus previously known by only one species, *Alcippus reticulatus* (Stål). The comparatively small size of the individuals immediately drew attention to them as being unique. *A. reticulatus* is recorded only from Brazil. The occurrence of a new species in Ecuador now extends the range of the genus across the northern portion of South America. The smaller size of the new species may possibly be accounted for by the higher altitude of the Ecuadorian habitat. A goodly number of the discocephaline pentatomids live in the detritus of the forest floor. It is very probable that this new species conforms to that behavior since many of the specimens examined showed signs of granular adhesions and minute bits of vegetable matter stuck to the bodies. The following description points out the significant characteristics that distinguish the newer from the older species.

Alcippus dimidiatus, new species
Figure 1

Much smaller than *Alcippus reticulatus* (Stål); 8 to 10 mm. long; broadly obovate, subtruncate behind in the female; fulvous above with brownish red to fuscous irregular clouding; punctures sordid red, fine and moderately dense; ochraceous beneath with fine reddish or brown punctures concentrated laterally. Over-all color above, dark brown.

Head nearly as long as medial length of pronotum; eyes not as prominent nor as pronouncedly subpeduncuate as in *A. reticulatus;* anteocular lobe almost twice as long as transverse diameter of eye and reaching halfway to apex of juga; jugal margins feebly reflexed, disc shallowly concave; apices of juga broadly rounded, much longer than tylus and broadly contiguous anteriorly, leaving a prominent V-shaped emargination apically between them; antennae about half length of body; basal three segments long-setose, terminal two densely pilose; segments I and II yellowish, coarsely conspersed with reddish castaneous spots, segments III, IV and the terminal two thirds of V fuscous, basal third of V and a narrow basal annulus on III and IV sordid yellow; segmental ratios: 15:35:32:40:45, i.e., segment II subequal to III or slightly longer.

Pronotum more than two and a half times as wide across the humeri as long medially; anterior apical angle devoid of a laterally or antrorsely projecting denticle; anterolateral margins subfoliaceous with a deep, V-

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shaped emargination midway along the length, dividing each margin into two lobes, an anterior subquadrangular one which extends well forward beyond eye, its external margin somewhat erose, and a posterior subtriangular one, the apex of which is acute and the posterior margin of which is sinuate just before humerus; humeri slightly tumid but the six transhumeral tubercles found in *A. reticulatus* here obsolete. A vague transverse shallow impression across disc before and behind cicatrices.

Scutellum somewhat paler than head and pronotum, its apex almost reaching fifth abdominal segment, margins behind point where frenum ends subparallel, apex subtruncate and weakly emarginate, its margins somewhat reflexed; base provided with two tumid elevations or large tubercles between which is a distinct saddle; crests of tubercles and four blotches across anterior margin dark brownish red; basal angles subcalloused, sordid ivory-yellow. Hemelytra darker and more densely and uniformly punctured than pronotum or scutellum; membrane barely exceeding abdominal apex, hyaline, crepe-like in texture, with four irregular, light brown veins between which are numerous small, circular light brown spots. Connexivum widely exposed, with anterior and posterior segmental angles, incisures, and sparsely distributed coarse punctures castaneous to dull red-brown; a slight elevation on each incisure near lateral margin; apical angles rectilinear and not produced, those of sixth segment of male obtusely rounded, those of female obtusely angled. Tergum orange-red.

Venter ochraceous; pleura sparsely punctured dull red; a broad band of finer castaneous punctures on abdomen below margin; spiracles dark castaneous; median abdominal furrow very broad and shallow, almost obsolete. Rostrum ochraceous, reaching fourth abdominal sternite, segment II much longer than III and IV combined, segment IV shorter than III, apex fuscous. Legs ochraceous, apical third of femora coarsely conspersed with red spots; sulcate surface of tibiae provided with dull red blotches and spots; basal and apical segments of tarsi, for the most part, dull red; tarsi, tibiae, and apical third of femora strongly setose.

Apical margin of male genital segment (Fig. 1-B) lunate, the lateral apical lobes apically rounded, barely exceeding sixth segment; heads of parameres subquadrate, protruding beyond margin of segment, connivent medially around and below proctiger, their inner margins semicircularly excavated so that, in repose, a medial circular hiatus appears between them. Basal plates of female genital valves (Fig. 1-C) subquadrate, about as long as broad, or slightly longer, lateral margins feebly sinuate, apical margins, taken together, forming a shallow concave arc; medial plate minute, almost invisible; apical plates small and not exceeding posterior margin of abdomen.

Described from ten specimens.

Holotype: Male: 8.0 mm. long; 5.0 mm. across the humeri; 5.75 mm. across greatest abdominal width. Baños, Ecuador (1°25′S., 78°24′W.), April 29, 1939; 1900 meters altitude. William Clarke MacIntyre, collector. From the Robert L. Usinger collection, deposited in the California Academy of Sciences, San Francisco, California.

Allotype: Female: 10.0 mm. long; 5.5 mm. across the humeri; 6.5 mm.

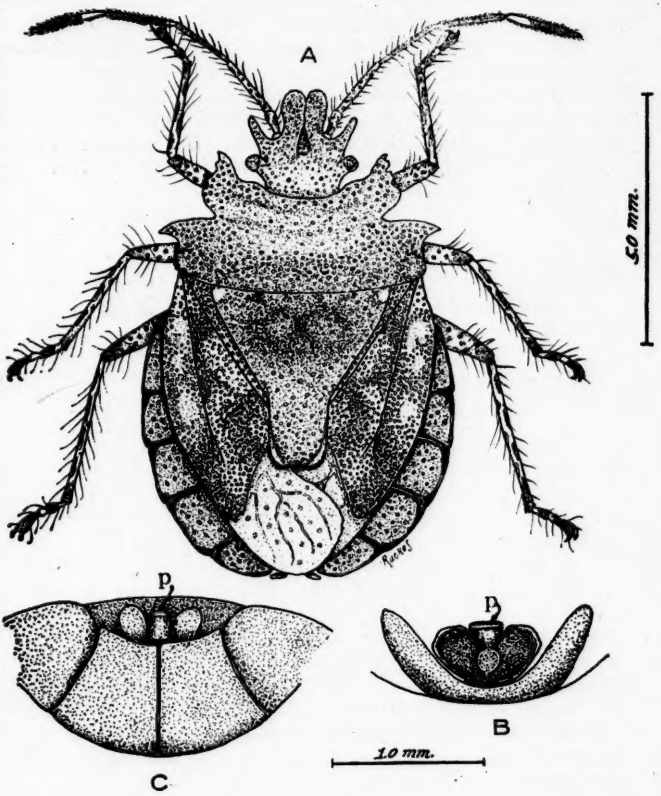

Fig. 1. *Alcippus dimidiatus*, new species. A, dorsal view of male holotype. B, male genital segment, ventral aspect. C, female genital plates, ventral aspect (p—proctiger).

across greatest abdominal width. Baños, Ecuador, May 3, 1939, 1800 meters altitude. William Clarke MacIntyre, collector. From the Robert L. Usinger collection, deposited in the California Academy of Sciences, San Francisco, California.

Paratopotypes: Males: April 22, 1939 (2), April 29, 1939 (1), deposited in the R. L. Usinger collection; April 22, 1939 (1), deposited in the American Museum of Natural History. Females: April 22, 1939 (1), deposited in the American Museum of Natural History; April 29, 1939, May 5, 1939 (2), deposited in the R. L. Usinger collection. The Usinger collection also contains three nymphal stages.

The only previously known species of *Alcippus* (*A. reticulatus* (Stål),

to which, obviously, this new species is related, is quite large, measuring some 15 to 17 mm. in length, and is considerably lighter in color. The diminutive size, the over-all dark brown color, the absence of denticulated anterior apical angles on the pronotum, the lack of six transhumeral tubercles, the presence of two prominent basal scutellar tubercles, the setose nature of the basal segments of the antennae, tarsi, tibiae, and apical portions of the femora, all are characteristics that readily separate *A. dimidiatus* from *A. reticulatus* (Stål).

BIOLOGY AND CONTROL OF *DERMATOBIA HOMINIS* (L. Jr.) IN HONDURAS[1] (Diptera: Cuterebridae)

HAROLD D. KOONE AND ALBERTO D. BANEGAS[2]

INTRODUCTION

Dermatobia hominis, known in tropical America as the "torsalo," is one of the most important parasites of cattle in Honduras. Considering the entire country it probably runs a close second to the combined species of ticks in damage caused to bovines. It is estimated that where torsalo infestations are heavy meat and milk production are cut at least 25%. Mortality, especially in younger animals, many times results from torsalo invasions followed by secondary infections. Hides from torsalo infested animals may be worthless or sell at a greatly reduced price. National or international quarantines may prevent the free movement of animals with torsalos from one area to another, thus reducing market possibilities.

Damage to cattle is caused by the larval stage of the torsalo fly, which burrows into the subcutaneous tissues. Any area of the animal is subject to infestation, but heaviest populations occur on the fore quarters and along the loin area. Large, swollen abscesses or cysts that contain excessive pus sometimes result.

This study was undertaken to obtain added information on the biology and control of the torsalo. The authors have been in close contact with torsalo problems in Honduras for the past five years. To our knowledge no prior recorded study of this insect has been made in the country. Information from other regions of Latin America leaves ample room for further investigations. Also conditions may vary greatly from one area to another. Limited funds and personnel have restricted the work here. It is hoped that this information may broaden the basis for better control of this dreaded pest.

Review of literature: The strange habit of the female fly of depositing eggs on the underside of the abdomen of other flies, depending on them to

[1] Published with the permission of the Director of USOM, Honduras.

[2] Entomologists with the International Cooperation Administration, U.S.A. and the Servicio Tecnico Interamericano de Cooperacion Agricola, Tegucigalpa, D. C., Honduras, respectively.

carry its offspring to the proper hosts, has attracted the attention of entomologists outside the tropics. Apparently this habit was first recorded by Dr. Rafael Morales in 1911 in Guatemala, and was confirmed by Dr. Núnez Tovar in Venezuela in 1912, when he succeeded in producing tumors on various animals by placing mosquitoes bearing eggs of *Dermatobia* on them (Surcouf, 1913; Knab, 1916). Mosquitoes were first noted as the vectors of the eggs of torsalo. Some doubts of these observations were to be expected and these were reviewed by Knab (1916) in his assembly of the evidence. Eggs on flies were secured in cages in 1917 by Niva and Gómez and the duration of the larval and pupal periods of six individuals were recorded.

Dunn (1930), working in Panama, gives a detailed account, sometimes daily notes, of the development of six larvae which he permitted to develop on his own person. Bates (1943) describes a habit of the adult *Dermatobia* in Colombia of riding on animals and pouncing on other zoophilous flies attracted to these animals, sometimes catching them in the air and depositing eggs on them. More recently Neel et al. (1955) found *Sarcopromusca arcuata* to be the most important vector in Costa Rica. The present writers' observations are in line with this.

The use of chlorinated hydrocarbons in control of ticks (Laake, 1949) probably introduced the spraying with these insecticides for control of the torsalo, to destroy the newly hatched larvae before it penetrates the skin of its host. Spraying cattle with 0.5% toxaphene at two week intervals has been commonly recommended by many observers and is specifically stated by Neel et al. (1955). It is noted that while this may be relatively successful, control is not complete. An attempt to destroy larvae already in their cysts by use of a smear was reported by Swain (1952).

A review of the literature is presented by Creighton and Neel (1952) and the present status of the problem reviewed by Hambleton (1957).

BIOLOGY

Distribution: Approximately one-half the area of Honduras can be classed as torsalo infested. Populations in cattle are heavy in most of the Department of Olancho and sizeable portions of the Departments of El Paraíso, Francisco Morazán, Yoro and Comayagua. Scattered, mostly light infestations occur in cattle in the Departments of Choluteca, Colón, Atlántida and Cortés. Other areas of the country probably have isolated infestations that have not been observed.

Hosts: In Honduras torsalo infestations have been reported from cattle, dogs, cats, rabbits, squirrels, mules, deer and man. A large group of hosts have been reported from other countries (Hambleton, 1957) including, in addition to the above, the following: swine, goats, sheep, horses, monkeys, lions, guinea pigs, chickens and other fowl.

Description of stages: The adult is a robust fly, similar in many respects to a number of blow flies. This fly does not have a hairy covering as does *Hypoderma*. Overall length is about 12 mm.; the abdomen is metallic blue in color, the thorax grayish blue and the head yellowish brown. Mouth parts are vestigial.

Individual eggs are about 1 mm. in length and .4 mm. in width. Their color is white, becoming almost gray with darker markings appearing just before emergence of the larva.

Newly hatched larvae are slender, somewhat narrower behind than in front. As the larvae develop they become almost pear-shaped, the posterior segments remaining narrow, but the anterior end becoming ovate to globular. Before reaching maturity the larvae become more ovate or egg-shaped. Larvae have twelve body segments. The first segment bears the mouthparts, which are equipped with a pair of hooks. The second segment has about 20 minute spines on the dorsum. Segments 3 and 4 each have one row of scattered, small spines located anteriorly and completely surrounding each segment. Segments 5, 6 and 7 each have one row of larger spines that encircles the segments. Immediately in front of the larger spines these segments have another row of small spines on the dorsal and lateral areas. The eighth segment has 10 to 15 minute spines on the posterior portion of the dorsum. Segments 9 to 12 inclusive have no spines. Just prior to pupation the anterior pair of spiracles are thrust outward and become quite prominent.

The puparia resemble mature larvae in general form. Anteriorly they are slightly flattened and are equipped with the pair of prominent, flower-like spiracles. The last larval skin hardens and serves as a shell for the pupa. This outer shell darkens with age becoming almost black by the time the adult emerges.

Life history and habits: Under laboratory conditions in Tegucigalpa and Danlí, at mean temperatures of 79° and 73° F. respectively, adults lived no longer than 6 days. Males lived longer than females. Under prevailing laboratory conditions temperatures were probably a few degrees higher than those found in the natural habitat of the adult fly, thus accounting for the rapid mortality. Apparently the adults take no food.

Adults in captivity began laying eggs the second day after emergence. The maximum number of eggs laid by a single adult was approximately 200. Other workers have reported up to 400 (Hambleton, 1957). When held in wire cages in the absence of vectors, adult females usually laid eggs scattered at random over the bottom of the cage. These eggs were usually attached end to end, similar to sausages in a string. On the other hand, under natural conditions where smaller flies are used as vectors, eggs are stuck to the underside of the abdomen or thorax of such flies. Arrangement of the eggs in this case resembles that of bananas upon a stem.

Adult torsalo flies were observed in large cages (10×6×8 feet) to capture and stick their eggs to the common house fly *(Musca domestica)* and to other torsalo flies. House flies were sometimes caught in flight and held closely by the torsalo fly while the eggs were stuck to the under surface of the body. This act usually ended upon the floor of the cage. Once the eggs are stuck to the vectors they are difficult to dislodge. Time required for deposition upon a vector was usually less than 30 seconds. Mosquitoes (*Psorophora* spp.) were used in cages with adult torsalo flies but appeared to be undesirable as vectors. Egg deposition upon vectors in the field was not observed by the authors.

It appears that under natural conditions torsalo flies are entirely dependent upon other insects as egg vectors. Only one incident has been observed by the writers in which an adult of *D. hominis* was found resting upon an animal. The flies are reluctant to fly. They appear to prefer damp locations where trees and bushes present a dense growth. Vectors are believed to be captured in proximity to cattle. Eggs remain attached to vectors even after hatching, the small larvae remaining inside the egg shells until the vector comes in contact with a suitable host (usually cattle). At this time the larva passes onto the vertebrate host through a door-like opening at the end of the egg. Empty egg shells remain attached to the vectors.

The incubation period for eggs under laboratory conditions at 80° F. was four to five. At this time the exit hole was clearly visible and half open. By stimulating the end of the eggs with a hair brush or heat from an ordinary light bulb a large percentage of the larvae were induced to make their exit. Larvae remained alive for two to three days after hatching.

When newly hatched larvae were transferred to a test animal they required one to two hours to burrow completely under the skin surface. One hour and 15 minutes were required for a larva to enter beneath the surface of the skin on the forearm of the senior author. There was an itching sensation at times but no pain.

A trial animal (four month old bull calf) was artificially infested with 100 newly hatched larvae. There was little or no migration of the larvae before making entrance. Three days after the initial infestation, small tumors could be seen on the animal. Larval emergence began 35 or 36 days later and was completed 42 days after infestation. Forty larvae developed and emerged.

According to other workers the larvae molt four times (Hambleton, 1957). In the earlier stages of larval growth the hole to the exterior is very small and appears to give little access to outside oxygen. Even after the larvae are approaching maturity the exit hole remains clogged with pus or exudate. Upon reaching maturity the larvae leave the animal, fall to the ground, enter beneath the surface and pupate usually within one day. Under laboratory conditions in Tegucigalpa the maximum depth of larval penetration for pupation was 10 cm., and the minimum was 2 cm. The average duration of the pupal stage for 2,000 pupae was 45 days, with a minimum of 35 days and a maximum of 58 days. The mean temperature during this period was 70° F., with a minimum of 62° and a maximum of 78° F. Upon emergence the adult leaves the puparium via the head end, a portion of which breaks free.

Climatic influence upon populations: Heaviest torsalo populations occur in Honduras in areas where rainfall is moderate to heavy (50 to 80 inches per year), temperatures reach neither extreme, and the dry season is rather mild. This area covers intermediate elevations of the country (1,500 to 4,000 ft.). Not all such areas as here described have torsalo infestations of great concern, for reasons that have not been explained.

Generally speaking, the torsalo infested area has two seasons, namely, wet and dry. Heavy rains do not occur after December 15, but high humidity and light rains are quite common until February 1. The rainy season

proper starts about May 15 to June 1 and continues, with a slacking off period in August, until December. The months of most intensive rainfall are September and October. Heaviest torsalo incidence occurs from October until March overlapping into the first part of the dry season.

Larvae that leave animals for pupation during the dry season proper probably have a high mortality rate. This is because the ground is hard, which makes surface penetration difficult; and even though they do enter the soil, the low moisture content is not favorable for survival of the pupae. As a result infestations begin decreasing about April 1 and continue to decline until well into the rainy season or about July 1.

Effect of soil moisture on survival: Laboratory work conducted in Tegucigalpa clearly demonstrated the effect of soil moisture on larval and pupal survival. Where 500 mature larvae (hand removed from cattle) were kept in a mixture of air-dry sand and sawdust, only 6 (1.2%) adult flies emerged. These were much smaller than normal and appeared to be poor specimens in general.

When excessive moisture was used 500 mature larvae yielded 46 (9.2%) adults. These appeared to be in normal condition. Execessive moisture was provided by using tin cans (4½ inches tall × 3 inches in diameter) with perforated bottoms which were placed in one-fourth inch of water. The cans were filled to within half an inch of the top with the sand-sawdust mixture. Mature larvae were released on the upper surface of the mixture and allowed to penetrate to any depth desired.

Five hundred additional mature larvae received similar treatment except water content of the mixture was 38% by weight. This was sufficient to make a moist situation but without free water. No further water was added but moisture was retained throughout the period. From these 500 larvae 254 (50.8%) adult flies emerged.

In securing material for rearing purposes the hand pressure method was used to remove mature larvae or larvae approaching maturity from cattle. Without doubt many of the larvae were injured during this process. This probably accounts for the fact that there was always around 50% mortality of the mature larvae or pupae under the most favorable conditions provided.

Egg vectors:[3] Egg vectors appear to be essential for the livelihood of the torsalo in Honduras. Six different species of flies have been collected with eggs of the torsalo fly attached. In all, several hundred vectors were captured. Screen wire traps baited with decaying meat were first used for trapping. This procedure was not very successful. Later, it was discovered by tying an animal that had running or oozing abscesses and posting a man to keep close watch was a faster method of capturing vectors. Flies with eggs attached are conspicuous, and when they alight on the animal it is easy to catch them in a shell vial. Animals used were tied in or near brushy places and in proximity to other cattle. By using this method, as many as 200 vectors were sometimes caught in a single day by one man. The number of eggs

[3] Identified by C. W. Sabrosky and F. M. Snyder, Entomology Research Division, U.S.D.A.

that each vector may carry is variable. The maximum found on a single fly was 80.

The following species of flies have been found to be vectors:

Family Muscidae—*Sarcopromusca arcuata* Tns., *Sarcopromusca sarcophagina* (v.d.w.), *Cyrtoneurina steini* Snyder, *Fannia* sp., *Stomoxys calcitrans* (L); Family Calliphoridae—*Callitroga macellaria* (F.).

The list of vectors given above is probably far from complete. In collections made to date approximately 90% of the total egg carriers have been *S. arcuata*. This particular species is a flesh fly, which is attracted to and apparently feeds upon the pus and exudate from abscesses that are present. Abscessed areas have many skin breaks which probably facilitate the entrance of newly hatched larvae.

A study of the life history and habits of *Sarcopromusca arcuata* is lacking. The fly somewhat resembles the common house fly but is slightly larger. Dorsally the thorax has three light colored longitudinal bands. The last abdominal segment has a rather large, irregular, yellowish area on each side. *S. sarcophagina* is very similar to *S. arcuata*.

Of the other species mentioned, both *Cyrtoneurina steini* and *Fannia* sp. appear to feed upon the pus discharge from torsalo abscesses. *Callitroga macellaria* is one of the common screw worm flies in Honduras and is attracted to wounds. *Stomoxys calcitrans* is the common stable fly. This fly is a blood sucker and prefers to feed from the legs or the lower portion of the animal's body.

CONTROL

Experimental work with toxaphene and DDT-BHC: Sprays containing toxaphene or a mixture of DDT and BHC have been used for the past few years in Honduras for controlling both torsalo and ticks on cattle. When applied at 15 to 20 day intervals these treatments have greatly reduced the larval populations of torsalo in cattle.

In torsalo control, results are usually not noticed until after two or three successive treatments with toxaphene or DDT-BHC. Larvae or grubs present in animals at the time of spraying are not adversely affected. The benefits derived from these sprays appear to be from the residual action of the insecticide upon the newly hatched larvae of the torsalo before or at the time of entrance into the skin and/or the repelling effect upon the egg vectors of the torsalo.

In 1955-56, 150 head of native cattle in the Danlí area were sprayed for one year at intervals ranging from 14 to 21 days with a mixture containing 0.5% DDT and 0.05% BHC. Another group consisting of 50 animals was likewise sprayed with .5% toxaphene. At the time of the first spray application these herds had estimated torsalo grub populations of 20 and 5 grubs per animal, respectively. After five successive treatments grub populations, although never eliminated, were reduced to an average of less than one per animal and remained at this level throughout the remainder of the test period.

In this particular experiment counts were made of any 25 mature animals at the time of each treatment. No attempt was made to remove the larvae

or grubs, but instead the animals were examined closely for the cyst-like pimples or abscesses that always result from the presence of the larvae. In case of large abscesses, those containing several larvae, estimates were made of numbers. Animals used in the above treatments were held in chutes for spraying. Care was taken in order to get complete coverage. A power sprayer was used, at a pressure of 200 to 300 pounds per square inch, to apply approximately three-fourths of a gallon of mixture to each animal. No control herd was used in this test, but untreated animals in adjoining pastures were observed during the entire period and always had torsalo populations much higher than the treated herds.

Experimental work with Narlene:[4] Narlene, a relatively new insecticide, was recently introduced into Honduras as a possible control for torsalo. The action of this material is quite diffrenet from those formerly used in that it is a systemic insecticide; that is, following applications to animals (orally or dermally) the toxic effect of the insecticide is absorbed and carried throughout the animal's body.

Limited experimental work with Narlene was carried out in late 1958 in the Danlí area. A detailed report of this work follows.

Methods and materials: Four groups of native cattle were used in these trials. Group No. 1 consisted of ten animals and was treated orally with a dosage of 20 mg. per kilogram of body weight. Since no facilities were available for weighing, a measuring tape for estimating live weight was used as a basis for calculating dosages. Group No. 2, also consisting of ten animals, was treated dermally with a spray mixture including .75% technical material. Sufficient spray was applied to thoroughly wet animals, amounting to approximately one-half gallon per animal. Both group No. 1 and No. 2 received two treatments, the second following the first by roughly one month.

The ten animals in group No. 3 received no treatment. Group No. 4 consisting of 25 animals received a single spray treatment.

Spray treatments were made with a two and one-half gallon pressure sprayer. Oral dosages were given with a drench bottle. All animals used in this experiment were marked with individual ear tags. All groups remained in the same pasture during the entire length of the trials.

Torsalo grub counts: Before insecticidal treatments were applied grub counts were made for all four groups. At the time of making the initial counts no larvae were removed. Instead, the cysts or small boil-like swellings, which are always present as a result of torsalo grub infestation, were counted. In cases of large abscesses containing several larvae, estimates were made of the number of grubs present. The initial counts and counts of the non-treated group may be in error as much as 25% as a result of this method. Counts were made of the treated animals 15 and 30 days after treatment. This was accomplished by hand removing all grubs, or in most cases the decomposed remains, and counting only the live ones.

Results: The results of these tests show that Narlene when used as a spray or oral drench gave practically 100% kill of larvae of *Dermatobia*

[4] O(4-tert-butyl-2-chlorophenyl) methyl phosphoramidothioate. Samples of this material were furnished without cost by Dow Chemical Company, Midland, Michigan, U.S.A.

encysted in cattle. Oral treatment appears to be slightly more effective than sprays and requires less insecticide.

The following table presents the results of these trials:

TABLE 1. Results of the application of Narlene as an oral drench and as a spray. Honduras, 1958.

Herd	Treatments	Number of Animals	Number Live Larvae		
			Initial Count	15 Days After Treatment	30 Days After Treatment
	Oral				
Lovo #1	1st. 15 Oct. 1958	10	742	0	116
	2nd. 18 Nov. 1958	10	116	0	0
	Spray				
Lovo #2	1st. 15 Oct. 1958	10	1434	10	168
	2nd. 18 Nov. 1958	10	168	0	66
	Checks				
Lovo #3	1st. 15 Oct. 1958	10	504	811	752
	2nd. 18 Nov. 1958	10	752	761	801
	Spray				
Lovo #3	19 Nov. 1958	25	2303	3	31

The mortality of *Dermatobia* larvae is quite rapid after animals have been treated with Narlene. Within 24 hours after treatment of heavily infested animals the dead, partially emerged larvae can be seen in large numbers. Later most of the grubs appear to be completely expelled from the animal. This is not true where large, infested abscesses are present. Oral dosages tend to act faster than sprays.

Reinfestation of treated animals was noticed after 30 days in some individuals. This was mostly confined to those animals that had large abscesses which had not completely healed and still presented some pus or exudate which attracted egg vectors. After the second treatment of these animals the old abscesses healed and reinfestation after 30 days was largely eliminated.

Narlene did not effectively control the various species of ticks that were present on the treated animals.

Recommendations: It appears that Narlene definitely has a place in torsalo control, especially in those herds in which infestations are extremely heavy and in which little control is being obtained from toxaphene sprays used mainly for tick control. Also, in every herd there are individual animals that always seem to carry heavy infestations of torsalo larvae. Narlene would be ideal to treat these animals. A combination of treating the heavily infested animals within the herd with Narlene and treating the entire herd with toxaphene or other sprays mainly for tick control might greatly diminish torsalo incidence.

At this time Narlene cannot be recommended for use on dairy cattle during the lactation period if the milk is being used for human consumption, nor should it be used within a period of 30 days prior to slaughter of animals for beef.

SUMMARY

The torsalo is a major insect pest of cattle in half the area of Honduras. The adult fly does not lay eggs directly on cattle but is dependent upon vectors (egg carriers). Six species of flies have been found to be egg vectors in Honduras, the most important being *Sarcopromusca arcuata,* a flesh fly. Vectors are attracted to and apparently feed on the pus exuded from torsalo abscesses, accounting for the continual infestation of animals on which such abscesses are present.

The torsalo thrives best in areas where rainfall is moderate to heavy and the dry season is not extreme. Dry soil is not favorable to surivival of the pupae. Heaviest infestations occur toward the end of the rainy season. Brushy pastures in damp locations tend to favor infestations.

The complete life cycle of the torsalo occupies 90 to 110 days. The parasitic (larval) stage lasts approximately 40 days.

Sprays at 15 to 20 day intervals with .5% toxaphene or a mixture of .5% DDT and .05% BHC reduced torsalo grub populations to a very low level. Three or four successive treatments were required before populations were greatly reduced.

Narlene given orally at 20 mg. per kilogram of animal weight or applied dermally as a .75% spray killed practically 100 per cent of the encysted grubs in cattle. Reinfestation was noticed 30 days after treatment but was limited mostly to those animals which had large sores or abscesses that had not completely healed.

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TAXONOMIC NOTES ON THE GENUS *AGENIELLA* (Hymenoptera: Pompilidae)

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The publication of Townes' revision of the pompilid subfamilies Pepsinae and Ceropalinae (U.S.N.M. Bull. 209, pp. 1-286, 1957) has resulted in a much clearer understanding of these groups than was possible previously. Because this work summarizes the taxonomy of the known Nearctic species and because probably only a few remain to be described, separate descriptive works have a considerably greater value than previously.

One new species and the hitherto unrecorded male of another are described in this paper. I wish to express sincere gratitude to Dr. H. K. Townes for examining the specimens and for providing material of other species for comparison.

Ageniella (*Priophanes*) *carolae* new species

Female: Length 6.6 mm. Forewing 4.5 mm. Integumental color of head and body uniformly ferrugineous, abdomen somewhat darker, apical segments of antennae and tarsi blackish. Pubescence rather sparse; vertex, clypeus, prosternum, anterior coxae, abdominal sterna and pygidium with a few erect hairs; thorax clothed with short, appressed, silvery-sericeous pubescence, density greatest on posterior face of propodeum and posterior surfaces of mid and hind coxae; each abdominal tergum with an apical silvery-sericeous band. Integument of entire body minutely reticulate. Head (fig. 4) broad, ocelli in a wide, nearly right triangle. Clypeus .40 as long as wide, frontal surface not strongly convex, with a row of large punctures slightly below middle, apical hairless portion mat, well set off from remainder by a transverse groove, not widened medially. Wings hyaline, apex of forewing with a faintly infuscate band. Nervulus of forewing meeting media beyond basal vein by .60 its length; second recurrent meeting third cubital cell .44 the distance from base to apex of cell. Teeth on outer edge of hind tibia moderately well developed, highest at base.

Male unknown.

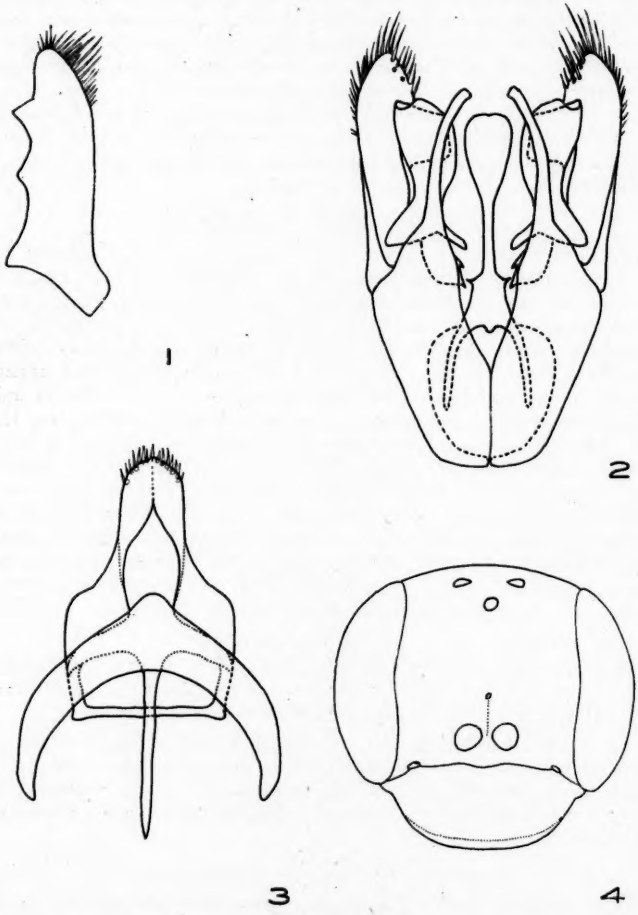
Holotype female, 2 miles east of Anza, Riverside County, California, on *Asclepias erosa,* July 7, 1956 (P. D. Hurd Jr.), deposited at the California Academy of Sciences, on loan from the California Insect Survey.

This entirely reddish species is superficially similar to *Ageniella rufescens* (Banks) and *A. arizonica concolor* Townes. It is most closely related to the former species and will run to it in Townes' key but is easily distinguished by the silvery bands on the abdominal terga and the piceous apical tarsal segment of the hind leg.

Ageniella (*Priophanes*) *fuscipennis* Townes

Male: Length 5.0 mm. Forewing 3.5 mm. Integumental color of head and body black, first abdominal segment and anterior half of second rufous. Pubescence sparse, temples, occiput ventrally and prosternum with a few slender erect hairs; lower face, clypeus, vertex behind compound eyes, meso-

sternum, first and second coxae and propodeum posterolaterally clothed with appressed silvery-sericeous pubescence; abdomen and legs with pubescence brownish. Clypeus .46 as long as wide, apical margin uniformly slightly convex. Wings subhyaline, faintly suffused with yellowish, apex without an infuscate band. Nervulus of forewing meeting media beyond basal vein by .30 its length. Third cubital cell .75 as high as long, receiving third recurrent



Figs. 1 to 3. *Ageniella fuscipennis* Townes. Fig. 1. Right paramere, exterior view. Fig. 2. Male genitalia, dorsal view. Fig. 3. Subgenital plate, ventral view.
Fig. 4. *Ageniella carolae*, new species. Head, frontal view.

vein at middle. Longer spur of hind tibia .44 as long and .62 as wide as hind basitarsus. Genitalia (fig. 2) with aedeagus strongly enlarged before apex, apical margin subtruncate. Paramere in lateral view (fig. 1) rather stout, dorsal margin nearly straight. Subgenital plate (fig. 3) with a distinct longitudinal, sub-basal, raised, apically acute flattened area, continuous to apex of plate as a poorly defined median fold; apex of plate with a marginal row of short stout spines.

Neallotype male, Coyote Creek, near Warm Springs, Alameda County California, September 20, 1958 (J. Powell), deposited at the California Academy of Sciences. Additional specimens have been seen from Norman and Artois, Glenn County California. These were taken on bare soil along an irrigation ditch and on flowers of *Foeniculum vulgare*. Flight dates range from July 22 to October 1.

In the series of males examined, there is little variation in the amount of rufous color on the abdomen. It is usually confined to the first two segments but on occasional specimens it extends to the basal portion of the third tergum. In contrast, the females have the abdomen black to almost entirely rufous.

Although Townes (op. cit.) mentions that the females of *Ageniella fuscipennis* are similar to those of *Ageniella arcuata* (Banks) and to *A. agenioides* (Fox), the male shows little similarity to the males of these species. The body is stout, and the tibial spurs are short. The tibial spurs of the hind legs are less than half the length of the basitarsus and are uniformly brown rather than white. The paramere in lateral view is broad with the dorsal margin straight rather than concave as in *A. arcuata*.

DESCRIPTIONS OF SOME NEW CERAMBYCIDAE FROM MEXICO AND SOUTHWESTERN UNITED STATES (Coleoptera)

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The following descriptions are offered in order to help clarify a synonymical problem in the genus *Crossidius* and to make available species names for other studies now in progress.

Paroxoplus new genus

Oxoplus Lacordaire (not LeConte), 1869, Hist. Nat. Insectes, Gen. Coleop., vol. 9, part 1, p. 179.

Body elongate, sides parallel; integument black and yellow. Head with front vertical; antennal tubercles slightly elevated, obtusely angulate; antennae filiform, eleven segmented, longer than body in male, with eleventh segment appendiculate, tapering, slightly shorter than body in female; eyes

finely granulate, strongly divided, upper lobe small; mandibles large, robust, bifid at apex. Pronotum transverse, rounded, strongly tuberculate at sides a little behind middle, disk convex, slightly uneven; scutellum prominent, longer than wide, acutely elongately triangular; prosternal process slightly expanded toward apex; sides of episterna of metathorax subparallel, narrow; mesosternum flat, not protuberant. Elytra with surface convex; finely costate but without ivory vittae; pubescence short, dense, punctation dense, moderately coarse; apices rounded or slightly sinuate-truncate, sutural angle not produced.

Type species: *Oxoplus ornaticollis* Lacordaire.

Paroxoplus is proposed for a species assigned by Lacordaire (1869) to *Oxoplus* LeConte (1862). Linsley (1955) has synonymized the LeConte genus with *Crossidius* LeC. However, the Lacordaire species does not agree generically with the species assigned to *Oxoplus* by LeConte, and together with *Oxoplus poecilus* Bates (1880), appears to require recognition as a distinct genus. The two species bear a striking superficial resemblance to *Parevander* Aurivillius in shape and ornamentation but can be readily distinguished by the reduced costae and flat mesosternal plate. The elongate form, robust mandibles, and over-all appearance will readily separate it from *Crossidius.*

The range of both *P. ornaticollis* (Lacordaire) and *P. poecilus* (Bates) appears to be the southern half of Mexico. Type locality for *ornaticollis* is Oaxaca and for *poecilus,* Tehuantepec.

Crossidius linsleyi, new species

MALE: form stout, robust; color black, appendages black, elytra dark testaceous with black sutural stripe having faint greenish overtones, broadly confluent with the wide basal band; punctation coarse, dense; pubescence fairly dense, suberect, and golden. *Head:* densely, moderately finely punctate above, pubescence thin, erect, pale, fairly long; antennae surpassing elytral apices by at least two segments, scape short, surpassing only second segment in length, fourth segment slightly longer than third and fifth, eleventh longest, appendiculate. *Pronotum:* wider than long, slightly inflated in appearance, sides evenly rounded, with small lateral tubercles; surface densely, moderately coarsely, contiguously punctured, punctures larger and deeper away from disk, finer punctures forming an ill-defined triangular area with three small punctate calluses on disk; pubescence very thin, pale, long; prosternum transversely impressed with an area of coarse, deep punctures, densely clothed with long fine, pale hairs; mesosternum and metasternum finely punctate, densely clothed with long pale appressed hairs. *Elytra:* about 2.3 times as long as broad, slightly wider than pronotum, sides subparallel; suture with black, submetallic stripe beginning slightly behind apices and joining broad basal band behind scutellum, basal band extending back over humeri to about basal one fourth of elytra; punctation coarse, dense, subconfluent, becoming finer apically, punctures at base approaching those of pronotal disk in size; pubescence dense, short, suberect and golden, intermixed with long, erect, pale hairs basally; apices rounded or slightly sinuate-truncate, slightly dehiscent. *Legs:* finely and densely

punctate, moderately clothed with suberect hairs, longer on underside of femora; anterior tibiae with dense pad of short pubescence along inner side. *Abdomen:* very finely punctate, densely clothed with thin, pale, appressed pubescence; fifth sternite broadly rounded at apex. Length 14 mm.; width 5 mm.

Holotype male, El Progreso, head of El Tajo Canyon, Sierra Juarez, Baja California del Norte, Mexico, September 10, 1958 (F. Truxal and J. Northern); one paratype, male, with same data.

The holotype is deposited in the Los Angeles County Museum and the single paratype in the collection of the California Insect Survey, Berkeley, California.

This species superficially resembles and is probably quite close to *C. hirtipes hirtipes* LeConte. However, *hirtipes* does not have the faintly metallic elytral markings of *C. linsleyi* nor the same configuration of the entire pattern. The discal pronotal punctation and elytral punctation of *linsleyi* also serve to set it apart from *hirtipes*. Discovery of the female will, in all probability, serve to distinguish *C. linsleyi* as a distinct species even more strikingly.

Crossidius nigrescens, new species

MALE: form stout, robust; color black and testaceous, abdomen pale to rufous, elytra dark with light area broad or only evident at sides, pronotum black or yellow; punctation moderate, dense; pubescence very short, suberect. *Head:* coarsely confluently punctate at vertex, more finely punctate on front; pubescence thin, sparse, moderately long; antennae long, surpassing elytral apices by about four segments, some segments carinate, eleventh segment long, appendiculate. *Pronotum:* wider than long, broadly rounded with distinct lateral tubercles; surface coarsely, deeply, separately punctured, disk with small impunctate callus behind middle; pubescence sparse; short, suberect, golden hairs on surface slightly interspersed with darker ones, hairs at sides longer; prosternum impressed in front of coxae forming a deeply, coarsely punctate, well defined area; long, erect, golden pubescence abundant; mesosternum and metasternum finely punctate, densely clothed with short appressed and longer suberect pubescence. *Elytra:* about 2.3 times as long as broad, slightly wider than pronotum, sides subparallel; yellowish areas usually greatly reduced to small spots at basal third and narrow stripes at margins, black areas with faint violaceous cast; punctation fine, dense, punctures separated, becoming finer apically; pubescence short, suberect, pale, with darker hairs intermixed; apices sinuate, slightly dentate at marginal angles. *Legs:* finely densely punctate, densely clothed with short, suberect hairs. *Abdomen:* finely densely punctate, sparsely pubescent; fifth sternite broadly rounded, very slightly emarginate at apex. Length 12-18 mm.

FEMALE: antennae shorter, seldom surpassing elytral apices. Length 14-19 mm.

Holotype male, allotype female and six paratypes (3 males, 3 females) Tepic, Nayarit, Mexico, September 15-24, 1953 (B. Malkin); additional paratypes: one male, Tepic, September 13, 1957 (R. & K. Dreisbach); one

male, one mile north of Tequila, Jalisco, Mexico, July 19, 1954 (J. W. MacSwain).

This species appears to be quite variable in size and coloration. There is a preponderance of black on the elytra of the type series, with only the allotype and the single male from Tequila showing any significant amount of yellow. There is also a tendency for the pronotum to be black in the dark forms.

C. nigrescens is quite distinct from other species of *Crossidius* because of its marked melanic tendency. The antennae are approached in length only by *C. ater* LeConte.

Xylotrechus sagittatus chiricahuae, new subspecies

Form of *X. sagittatus sagittatus* (Germar) but darker brown in color. Size larger, ranging from 12 to 26 mm. Pronotal asperites quite pronounced, and sutural pubescent fasciae of elytra distinctly separated from marginal ones; fasciae distinct.

This subspecies can be differentiated from the nominotypical form by the darker color, larger size, and the more pronounced pronotal carinae.

Holotype male, allotype female, and 21 paratypes (8 males, 13 females) Southwest Research Station, Chiricahua Mountains, Arizona, 13-23 August 1958, on *Pinus chihuahuana* (P. D. Hurd), 16 August 1958, on *Pinus chihuahuana* (E. G. Linsley), 30 August on *Pinus chihuahuana* (G. Hurd), 28 August 1958 (R. F. Rice), 5 August 1955 (E. Ordway); additional paratypes as follows: 3 males, 3 females, 5 miles west of Portal, Cochise County, Arizona, 26/27 August 1957 (W. F. Barr); 10 males, 6 females, 5 miles west of Portal, 11-22 August 1958, on *Pinus chihuahuana* (J. M. Marston, D. D. Linsdale, P. M. Marsh, P. D. Hurd, and P. A. Opler).

This subspecies occurs in the Chiricahua Mountains of southeastern Arizona.

The author gratefully acknowledges Dr. E. G. Linsley, University of California, Berkeley, for aid and suggestions in the preparation of the manuscript.

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SOME BIOLOGICAL OBSERVATIONS ON *PHILANTHUS POLITUS PACIFICUS* CRESSON (Hymenoptera: Sphecidae)

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Members of the genus *Philanthus* are solitary ground nesting wasps which provision their nests with hymenopterous prey, primarily bees of the family Halictidae. Of the 23 described species in North America, the biology of only one, *Philanthus gibbosus* (Fabricius), has been reported with any degree of completeness (Peckham & Peckham, 1898; Rau & Rau, 1918; Reinhard, 1924; Krombein, 1936, 1952, 1956). The outstanding work was a two-year study done by Reinhard, in which he found some 22 bee species utilized as prey. Of these, 21 were halictids, the other a panurgine andrenid. Information on the biology of the remaining species of *Philanthus* in North America is lacking except for fragmentary observations (Peckham & Peckham, 1905; Rau & Rau, 1918; Krombein, 1936; Bohart, 1954; Evans, 1955; Lin, 1957). Recently honeybees have been recorded as prey for *P. flavifrons* Cresson by Bohart (1954) and for *P. sanbornii* Cresson by Evans (1955), this being a habit long known for the European *P. triangulum* Fabricius. Although the prey in all these studies consisted entirely of bees, a colony of *P. politus pacificus* Cresson at Antioch, California has been found to provision with species of several wasp families as well as halictid and andrenid bees.

Preliminary observations on the population of *P. politus pacificus* at Antioch, Contra Costa County, California, were made on September 17, 1958, and subsequent investigations were conducted during most of the day on September 25 and October 3. Weather throughout the period of observations was clear and quite warm, with winds occurring during the afternoons. The surface temperature of the sand remained high during most of the day.

The area of the nesting site is one of a few small remaining portions of the once extensive Antioch sand dunes. These dunes have long been known as an excellent habitat for a variety of fossorial wasps and ground nesting bees. Due to recent industrial expansion, the dune areas have been reduced to a few small isolated spots. The *Philanthus* site was located just east of the city near a municipal sewage plant. A few dunes there have remained relatively unchanged, but the wasps had selected a level area which had been partially disturbed by trucks and other vehicles. The soil consisted of fine, rather hard packed sand. It was estimated that there were over 50 active female wasps within an area approximately five by ten meters, but the burrows were more or less concentrated in two separate areas. Even so, the burrows were somewhat scattered within these two areas, the most closely associated group (four active nests) being located within a circle one-half meter in diameter. Each of the two zones in which the burrows were concentrated consisted of a series of ill defined shallow depressions which had collected a thin layer of loose, windblown sand. Vegeta-

tion in the vicinity was very sparse, consisting of scattered perennial lupine bushes and a small amount of grass, and none was present within the two zones occupied by wasp burrows.

Hundreds of males were active at the time of our observations and were concentrated primarily in large groups (20 or more individuals) flying about the roadways near the nesting site. Males became active in the morning shortly after the females. The first of these were seen by 9:00 a.m. (Pacific Standard Time). As activity increased, groups of five to ten males could always be seen coursing over the burrow sites about one or two centimeters above the surface of the sand. However, during the entire day the greatest majority of males were active outside the actual nesting site. Occasional individuals among those coursing over the burrows were seen to harass or tumble females engaged in digging activities, but in spite of the large numbers of males present, no instances of mating were observed.

P. gibbosus (Fabricius) has been reported to spend the night in the burrow by Peckham & Peckham (1898) (given as *P. punctatus* Say) and by Reinhard (1924). Freshly emerged males and females were found to live together for a time in the original nest before starting out independently. This association continued for several days before the females began burrow construction. Later, males either dug shelters or utilized crevices, etc., to which they returned night after night. On the basis of morning observations, we concluded that the males spend the night away from the nesting site. Although the area was kept under close surveillance previous to and during the appearance of females, no individuals were observed opening burrows from within, and their night resting place is unknown. The first female was seen at 8:15 a.m., and during most of the following hour individuals became more numerous. At this time females were engaged in short, hovering flights, which were interrupted by periods of remaining motionless on the sand.

Digging activities commenced shortly after 9:00 a.m., when several wasps were seen engaged in burrow construction. While digging, the female usually backed out, kicking the sand backward with her fore legs. Upon reaching the surface, the wasp continued to dig and re-entered the tunnel. After she was out of view, the digging was still evidenced by small jets of sand spurting out of the entrance, and these gradually diminished as the wasp descended. At intervals the accumulation of sand at the entrance was spread out by a characteristic process. The female backed or flew three or four centimeters distant and spread the sand by kicking it back as she returned to the burrow entrance. Often this action was repeated several successive times. The digging activities observed were being carried out in burrows which had been started previously, and most of these were completed by noon of the day of observation. This suggests that construction of these nests probably was commenced during the previous afternoon.

As mentioned above, almost every female had selected a spot for nest construction at a place where the wind had accumulated a layer (1-3 cm.) of loose sand. However, there seemed to be no indication of preference with regard to minor features of topography, depth of the loose sand or the direction toward which the burrow entrance was oriented.

Upon termination of the digging, the female covered the tunnel entrance from outside by an involved process before flying off in search of prey. Beginning at the entrance, she worked her way outward for several centimeters, usually in a somewhat curving path. She kicked the loose sand back in much the same manner that she distributed it during the digging operation. This action was repeated again and again, the wasp backing or flying back to the entrance each time to start again. After the tunnel entrance was filled, the *Philanthus* female continued to rake the sand around the burrow in all directions for several centimeters. Frequently she experienced some difficulty in locating the position of the entrance, scratched in a path beyond it, then returned to search for the place from which to start the next divergent path. As the process continued, the curving paths were lengthened until the jets of sand fell short of the burrow, and much of the later stages of the process, which took up to ten minutes, seemed to be wasted effort. In one instance a female had selected a high spot where the layer of loose sand was lacking, and the burrow entered directly into the hard packed substrate. In the nest covering process the wasp moved outward further than any of the others observed, but with insufficient loose sand to cover the entrance fully, she ultimately flew off without completely concealing it. In the normal cases, long after the burrow had been obliterated to our eyes, the wasps repeated a few short hovering flights and finally flew off. On subsequent departures, this process was reduced and varied considerably. Some of the wasps were observed, after bringing prey in, to carry out three repetitions of the outward movement in a pathway. Others left by flying directly out, the entrance being filled with loose sand as the wasp emerged.

Provisioning appeared to progress rather slowly. Among those burrows under observation, a maximum of four prey was brought in by a *Philanthus* female during a four-hour period. Prey-laden wasps began appearing about 9:30 a.m. and continued throughout the warm part of the day. However, at times a particular female was not seen for several hours, and it was assumed that prey hunting was interrupted by periods spent inside the nest or feeding at flowers. Even so, the wasps were usually gone for 40 minutes or more on foraging flights. We did not observe the capture sequence nor the source of victims, but judging from the diversity of prey and the time intervals involved, it was presumed that there was no concentrated source of provisions. Occasional individuals of some of the prey species (i.e., *Chloralictus, Xylocelia*) were netted on flowers or on bare sand within a few meters of the nesting site. The time spent on hunting trips probably is correlated with proximity and availability of prey. The Peckhams (1898) report a case of a female *P. gibbosus* having brought in 13 bees of the genus *Halictus* in about three hours, when there was a large colony of these bees nesting nearby.

Upon arriving at the nest with prey, the female of *P. politus pacificus* usually flew straight to the entrance, dug its way in with the fore legs and entered directly, without ever relinquishing the paralyzed victim. The time required to enter with prey varied considerably. The entry was usually accomplished in about five seconds, but sometimes up to 45 seconds were

spent in scratching about and removing the loose sand left in the tunnel entrance. The burrow was left more or less open while the wasp was inside, and she generally reappeared soon. The time spent within the burrow varied from 20 seconds to one minute 50 seconds in those observed. Occasionally difficulty was experienced in locating the entrance to the nest. In one instance the prey was dropped while the *Philanthus* scratched about, and after opening the burrow, she backed down dragging the paralyzed bee in with her mandibles. On another occasion a female appeared carrying a vespid, and upon entering an open burrow, she reappeared almost immediately without it. The immobile prey then appeared, having been pushed up by the owner of the burrow, a small bembicid. The *Philanthus* attempted to enter this misidentified nest several more times, once staying inside together with the bembicid for about 25 seconds, but she finally flew off, leaving the prey lying outside the nest.

The 35 prey taken from *Philanthus* females or from burrows were of 14 species representing six families of Hymenoptera. These were as follows.

Ichneumonidae:	
Diplazon laetatorius (Fabricius)	1
Braconidae:	
Chelonus texanus Cresson	1
Sphecidae:	
Xylocelia species	11
Solierella blaisdelli (Bridwell)	1
Undetermined species (Psenini)	1
Vespidae:	
Stenodynerus valliceps Bohart	1
Andrenidae:	
Perdita interserta ciliata Timberlake	2
Halictidae:	
Sphecodes species (undescribed)	4
Chloralictus incompletus (Crawford)	1
C. species near *incompletus* (Crawford)	1
C. tegulariformis (Crawford)	1
C. near *actinosus* (Sandhouse)	6
Halictus tripartitus Cockerell	2
H. ligatus Say	2

As stated above, all the previous prey records for North American species of *Philanthus* have been Apoidea, primarily Halictidae. Halictids were the predominant group taken by *P. politus pacificus,* but these were not preferred by all of the individuals. There appeared to be considerable individual variation in prey preference. Ten of the eleven *Xylocelia* were found in a single burrow, both *Perdita* had been provisioned by one *Philanthus,* and three of the four *Sphecodes* were unearthed in a single tunnel. It is supposed that preference is due to the return of female wasps to the source where they find prey readily available. The *Chloralictus* were distributed among five *Philanthus* nests, and two females had each provisioned

two species. It seems likely that these bee species were visiting flowers together.

An interesting problem was encountered when the burrows were excavated. In no case were we able to discover a cell, provisioned or otherwise. The prey was always heaped at the end of the tunnel, without any sign of a cell constructed there. One tunnel contained eleven prey (ten *Xylocelia* and one braconid), without any sign of a cell or an egg. Furthermore, careful excavation of the hard-packed, dry sand adjoining the entire length of the tunnels revealed no closed-off cells such as those described for *P. gibbosus* by several workers. Those burrows in which prey was found consisted of simple tunnels 3-4 mm. in diameter, varying from 17 to about 22 cm. in length. These entered the sand in a gradual (about 25°-30°) slope, curving in various directions, sometimes almost in a circle, and ending about 8-12 cm. below the surface. Excavations were attempted October 3 on several burrows which had been marked on September 25. Although provisioning was in progress in each on September 25, such was not the case on the later date. In each case the excavation attempt ended in failure, as the tunnel had been completely filled with loose sand. (Due to the extreme abundance and diversity of aculeate hymenoptera nesting at the Antioch site, excavation almost always reveals a variety of tunnels and filled burrows which are a source of confusion to the observer.) Painstaking search failed to unearth a fully provisioned cell.

On the basis of these observations, we concluded that *Philanthus politus pacificus* Cresson probably does not construct an intricate system of cells with each nest such as that described for *P. gibbosus* (Fabricius). Rather, it seems a definite possibility that the female of *P. politus pacificus* digs a new burrow for each cell, and further that the cell is not constructed until a full complement of prey has been accumulated. The latter habit is known for certain other sphecid wasps (e.g. *Astata;* Evans, 1957), but no indication of this has been reported in previous studies for the North American species of *Philanthus*. Reinhard (1924) states that the tunnel of *P. gibbosus* ends in an unprovisioned cell before prey gathering is initiated.

It is reported by Reinhard that the colony of *P. gibbosus* under study was parasitized by two miltogrammine flies, *Metopia leucocephala* Rossi and *Senotainia trilineata* van der Wulp, and he states that the former probably larviposits in the tunnel entrance. At the Antioch site, specimens of the latter were collected, along with other sarcophagids, *Sarcophaga nana* Coquillett, *Eumacronychia decens* Townsend, *Hilarella hilarella* Zetterstedt, and *Taxigramma heteroneura* Meigen. In addition, parasitic wasps of five genera of Chrysididae (*Hedychrum, Hedychridium, Parnopes, Chrysis,* and *Omalus*) were taken in flight about the nesting area. However, due to the diversity of species nesting there at the time, and the fact that we found no cells of the *Philanthus,* there was no conclusive evidence as to parasitism in the colony.

We are indebted to the following specialists who kindly determined the insects recorded above: Dr. R. M. Bohart, University of California, Davis (the *Philanthus,* Vespidae, and Chrysididae); Dr. C. F. W. Muesebeck, U.S. National Museum (Braconidae); Prof. H. J. Reinhard, Texas A. & M.

College (Sarcophagidae); Prof. P. H. Timberlake, University of California, Riverside (Apoidea); Miss L. M. Walkley, U.S. National Museum (Ichneumonidae); and Dr. F. X. Williams, La Mesa, California (Sphecidae). Acknowledgment is also made to Marius S. Wasbauer, University of California, Berkeley, for reading the manuscript and offering helpful suggestions.

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NOTES ON THE TAXONOMY OF THE FOSSIL XYELIDAE (Hymenoptera: Symphyta)

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Seven fossils of the primitive sawfly family Xyelidae have been reported in the literature from two different localities and time strata. The oldest fossil representing a living hymenopterous family is the xyelid, *Liadoxyela praecox* Martynov (Martynov 1937), which was found in the lower Jurassic beds of Kisyl-Kiya, Turkey. The remaining six fossils all came from the Oligocene rocks of Rott, Germany (Meunier 1920, Statz 1936).

The fossil of *L. praecox* consists of a positive impression of an anterior wing which lacks the apex, anal, costal and subcostal areas. The familial relationship of this species can be deduced from the three marginal cells and general conformity of the other vein remnants to equivalent veins in the wings of *Macroxyela* Kirby and *Xyelecia* Ross. Since the subcostal vein (Sc) is missing, the establishment of a closer relationship to living genera is not possible.

The first xyelid fossil recovered from the Oligocene beds of Rott was

described as a new genus and species, *Pinicolites graciosus* Meunier (Meunier 1920). The type specimen is an almost complete positive impression of the dorsum with the posterior part of the thorax and the anterior part of the abdomen absent. The right fore- and hind-wings are twisted together, and the left forewing is folded in the anal area and has the wing apex missing.

The taxonomic position of the genus remained unchanged until Statz (1936) found another specimen of the same species in the Rott locality. Comparison of Statz's (1936) drawing of his specimen and Meunier's (1920) photograph of the type shows the conspecific status of these two fossils. Statz's material consisted of both a positive and negative impression. The dorsal view has the antennal segmentation more clearly defined, both fore- and hindwings prostrate and spread open, and the saw-sheath clearly outlined in a nearly lateral view. On the basis of antennal and wing venational characters, Statz moved *Pinicolites graciosus* to the modern genus *Pleuroneura* Konow. Based upon my studies of the family Xyelidae in North America, I believe the generic change from *Pinicolites* to *Pleuroneura* is unjustified.

The fossil genus *Pinicolites* Meunier can be distinguished from the living genera *Megaxyela* Ashmead, *Macroxyela* Kirby and *Xyelecia* Ross by several distinctive characters. All three of these genera have their ovipositor sheath very short, not extending beyond the abdomen. *Macroxyela* and *Megaxyela* also differ in that vein Sc_2 joins R after the separation of Rs, and the antennal thread of *Xyelecia* has 24 segments and is longer than the third antennal segment.

The separation of *Pinicolites* from the remaining extant genera, *Pleuroneura* and *Xyela* Dalman is more difficult, but the differences are still obvious. As shown in Table I, the fossil differs from *Pleuroneura* only in the length and shape of the saw-sheath. However, the dissimilarities in this structure readily distinguish the two genera. In contrast, the sheath of *Pinicolites* appears identical to that of many species of *Xyela,* but the antennal structure and wing venation are greatly divergent.

Because of these morphological differences from living genera, it seems more logical to leave *Pinicolites graciosus* in its original genus, *Pinicolites,* rather than to enlarge the concept of the genus *Pleuroneura* to include it. *Pinicolites* would then be characterized by having the antennal thread shorter than the third antennal segment and nine segmented; the forewing with Sc distinct from R, and Sc_2 present, joining R before the separation of Rs; hindwing with R and M fused; and the saw-sheath (including estimated length of the valvifer which lies beneath the abdomen) as long as the abdomen, the dorsal and ventral margins parallel for most of length and the ventral margin convex.

In his 1936 paper Statz also describes three additional species of fossils which he places in *Xyela.* The evidence given in the text and in his illustrations indicates a probable synonymy of *X. latipennis* Statz and *X. angustipennis,* when compared with variation as found in living species. The length and shape of the ovipositor are close to that of *X. julii* Brebisson. These fossils may represent a direct ancestor of this common Palearctic species.

TABLE I. Characteristics separating *Pinicolites* Meunier, *Pleuroneura* Konow and *Xyela* Dalman.

	Pleuroneura	Pinicolites	Xyela
No. segments in antennal thread	6-12	9	9
Ratio of antennal thread to 3rd antennal segment	shorter	shorter	as long as or longer
Vein Sc in relation to vein R	distinct and well separated	distinct and well separated	either fused or closely aligned
Where vein Sc_2 joins vein R in relation to where Rs separates from R	joins R before separation of Rs	joins R before separation of Rs	either joins R before separation of Rs or is absent
Length of saw-sheath compared with length of abdomen	shorter	longer	variable, ranging from shorter than to 3× the length
Shape of saw-sheath	dorsal and ventral margin tapering from origin to apex; ventral margin concave	dorsal and ventral margins parallel for most of length, apex rounded; ventral margin convex	dorsal and ventral margins variable, usually parallel for most of length; ventral margin usually convex

Statz (1936) claims that his *Xyela* spp. could not be on conifers as gymnosperms are unknown from the Rott flora. However, the living species of *Xyela,* some of which are nearly indistinguishable from the fossils, are known to develop only in the staminate cones of pines. The adults are voracious feeders on pollen and prefer the larger amounts and more readily available pollen of anemophilous plants such as *Salix, Betula* and *Alnus.* Statz (1936) in his discussion of the genus *Leucempria* (Tenthredinidae) mentions that three species of birch (*Betula*) are known from the Rott flora. As this genus of trees is a common food source for the adults of *X. julii* today (Benson 1954), it seems likely that the pines were nearby, and the adult *Xyela* were preserved near their pollen source.

I wish to thank Drs. W. W. Middlekauff and P. D. Hurd, Jr. for their help in the preparation of this paper.

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INTRAPOPULATION VARIABILITY AS A RESTRICTIVE FACTOR IN THE USE OF FREE AMINO ACIDS IN COMPARATIVE TAXONOMY[1]

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Since the perfection of microchromatographic techniques in 1944, a number of papers have been published on the free amino acids in insect tissue and blood. While much of this work has been exploratory and has dealt essentially with a qualitative analysis of tissue and blood for free amino acids, the possibility of utilizing these compounds as tools in systematics has been proposed by several authors (Ball and Clark 1953; Lewallen 1957; Micks 1954 and 1956; Micks and Ellis 1952; Micks and Gibson 1957). These authors suggest that the degree of similarity in the free amino acid patterns is a direct indication of the relationship among the insects tested. Micks and Gibson (1957) and Lewallen (1957) both report that qualitative and quantitative differences in ninhydrin positive spots can be determined in different strains of the mosquitoes *Aedes aegypti, Anopheles quadrimaculatus* and the species of the *Anopheles maculipennis* complex.

This is to be considered as a preliminary investigation on the intrapopulation variability of twelve amino acids in the blood of a single population of the American cockroach, *Periplaneta americana* (L.), to determine whether the magnitude of variability is sufficient to question the use of this technique in taxonomic discrimination among congeneric species. This question appears to be particularly pertinent as preliminary two-dimensional paper chromatographs run on the *Periplaneta* species, *americana, australasiae* (Fabr.) and *brunnea* Burm., reveal no qualitative differences in the spotting.

Only females of these three species were used for comparison of quantitative differences among the amino acids under study, for the inclusion of the males would only introduce another variable.

METHODS

Three species of *Periplaneta* were selected for this study because of their availability, ease of rearing and ease of sampling. Insofar as could be determined all females used were two months old and were unmated. All roaches were reared on identical diets until shortly before samplings were made. Each individual was isolated and starved for two weeks prior to blood analysis. There is no assurance that starving will totally eliminate the nutritionally induced variation of free amino acids in the blood; however, our feeding trials indicate that it will minimize this variation.

Blood analysis was accomplished by ascending paper chromatography, using a modified method of Block and Weiss (1956). Five samples were

[1] Aided by grants from the Graduate School Research Fund and Basic Research Committee, Oregon State College. Technical Paper No. 1173, Oregon Agricultural Experiment Station.

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applied to each 7 × 11-inch sheet of Whatman No. 1 filter paper and permitted to dry before being developed. A single solvent system was used to separate the 12 amino acids selected for comparison, as it was felt that these would serve to indicate the variability that could be expected in the other amino acid groups separated in this and other solvent systems. The BAW solvent system was prepared by mixing n-butyl alcohol, acetic acid and water in proportions of 250: 60: 250 v/v. Upon separation the lower (aqueous) phase was drained into beakers and the upper (alchohol) phase used as the solvent. The beakers containing the aqueous phase were placed in the chamber.

The five spotted sheets were hung from glass rods, using stainless steel clips, and the glass rods were mounted on a stainless steel frame. The unit with the spotted paper was mounted in the chamber so that the lower ends of the suspended sheets were just above the solvent level. The chamber was then sealed and permitted to equilibrate for an hour. Following equilibration suffiicient solvent was added to bring the level to within 1.5 cm. of the application line. The chromatogram was developed until the solvent front reached a point 25 cm. above the line of application, air-dried, and developed twice more to the same level.

Densitometric readings using a photoelectric densitometer (Photovolt Corp.) were made 24 hours after staining with ninhydrin and the maximum density recorded.

As paper chromatography and densitometric readings are notoriously variable, every effort was made to standardize the analytical techniques. The method outlined above permitted us to run twenty-five samples per chamber, and by closely controlling the solvent level, paper position in the solvent, equilibration of the paper in the solvent-saturated atmosphere of the chamber, and the temperature at which all separations were made, we feel that the variability attributable to the technique has been minimized. Evidence of the replicability is indicated in table 1 where the range of densitometric values for each amino acid from the triplicate runs on a single specimen each of *P. australasiae* and *P. brunnea* are recorded.

A four lambda blood sample was taken from each female by direct heart puncture through the dorsal intersegmental membrane, and applied to the paper. The coagulum remained at the point of application. Samples from each specimen were run in triplicate.

One hundred females of *P. americana* were sampled during the course of these investigations. The limits of recorded maximum density for each of the twelve amino acids from the 100 specimens and an average density value are recorded in table 1. Two mature, starved feamles each of *P. australasiae* and *P. brunnea* were sampled as above and run in triplicate.

As this study was comparative rather than definitive, the actual amounts of amino acids are not determined. The readings merely represent the maximum color density for each of the twelve amino acids selected for analysis.

RESULTS

Through observation the differences in the densities of chromatographs of the different individuals of *P. americana* appear to be minor. Upon

densitometric evaluation, however, the quantitative differences are strikingly large.

The high and low readings for each of the twelve amino acids from the 100 American roaches sampled are listed in column 1 of table 1. These limits represent over twelvefold differences in the amount of leucine and isoleucine, sixfold in alanine, fivefold in cystine, fourfold in methionine and valine, and differences of lesser magnitude in the other amino acids.

TABLE 1. Maximum density readings of Ninhydrin spots from the blood of adult females of three species of cockroaches using BAW as solvent.

AMINO ACID	*P. americana* limits	*P. americana* average 100♀	*P. australasiae* average 2♀	*P. brunnea* average 2♀
CYSTINE	.08-.38	.21	.15±.01	.15±.01
HISTIDINE	.38-.67	.54	.65±.025	.58±.025
ARGININE	.24-.63	.47	.33±.01	.35±.04
SERINE	.34-.96	.61	.61±.03	.48±.005
GLYCINE	.51-.69	.59	.65±.05	.47±.01
GLUTAMIC ACID	.14-.30	.20	.20±.005	.26±.03
ALANINE	.13-.76	.47	.21±.01	.17±.00
TYROSINE	.15-.47	.23	.21±.02	.38±.005
METHIONINE & VALINE	.10-.44	.27	.17±.00	.18±.01
LEUCINE & ISOLEUCINE	.04-.51*	.27*	.16±.01	.23±.03

* average of 10♀ *P. americana*.

The second column in table 1 represents an average densitometric reading for each of the twelve amino acids in the American cockroach. As the plotting of densitometric frequencies for each amino acid would require more space than the conclusions would justify, it should be noted that in cystine 23 per cent of the readings gave values of less than 0.16; 41 per cent fell between 0.16 and 0.30; and 36 per cent were over 0.30. Similar distributions would result from plotting the frequencies of all the amino acids sampled in this study.

Columns 3 and 4 of table 1 present the averages of the triplicate samples from two specimens each of *Periplaneta australasiae* and *brunnea*. All twelve amino acids from the blood of both these species fall within the respective limits of variability obtained from those of the 100 specimens of *P. americana;* in fact, the average density reading for each closely approximates the average value computed for the latter species. It is obvious from these data that erroneous conclusions could be drawn on the species specificity of blood amino acids, particularly where limited population samples are used.

In columns four and five of table 1, the mean densitometric reading is followed by a citation of the maximum range of variation in the scans for each amino acid in the triplicate runs of the two specimens used. For example, in *P. australasiae,* the mean intensity of the ninhydrin spot in the triplicate runs for cystine in specimen 1 was 0.12 ± 0.005; in specimen 2 the mean of the triplicate was 0.17 ± 0.01. In the table the average density

reading is cited as 0.15 ±0.01, as it was in the second specimen that the maximum range in color density of this spot was recorded.

The data were not subjected to statistical analysis for two reasons. First, this is not intended to be a comprehensive study of amino acid variability, and second, the submission of the data to a statistician has confirmed our impression that the analysis of obviously significant data is unwarranted.

It is interesting to note that the concentration of each amino acid apparently acts semi-independently of all others. Table 2 presents the analytical data on seven amino acids taken from eight adults of *P. americana*. Again, the figures represent the maximum color density of each amino acid, as they are primarily for comparative purposes. The specimens are listed in order of the relative concentration of cystine in each, with individual number 1 representing the lowest concentration (0.14) and specimen number 8 the highest (0.38). The lowest concentrations of the six other amino acids are italicized and the highest concentrations of each asterisked for ease of comparison. Each densitometric value represents an average of triplicate runs.

TABLE 2. Quantitative comparison of seven amino acids from eight female specimens of the American cockroach.

Specimen No.	Cystine	Histidine	Arginine	Serine	Glycine	Glutamic Acid	Alanine
1	*.14*	.52	.41	.57	*.54*	.30*	.48
2	.16	.52	*.39*	*.48*	.56	.19	.49
3	.17	.52	.52*	.61	.62	.23	.64
4	.18	.51	.40	.59	.58	.20	*.38*
5	.19	.60*	.53	.73*	.59	.18	.66*
6	.20	*.44*	.43	.64	.61	.19	.48
7	.37	.53	.51	.82	.65*	*.15*	.59
8	.38*	.50	.49	*.48*	.55	.22	.44

— *Italic* figures represent the lowest concentration of amino acid among the eight specimens.
* *Asterisked* figures represent the highest concentration of amino acid among the eight specimens.

Specimen number 1 having the lowest concentration of cystine had the highest concentration of glutamic acid, and specimen number 8 with more than two and a half times the cystine taken from specimen 1, had the lowest concentration of serine and next to the lowest concentration of glycine, alanine and histidine. The high and low concentration for each of the other amino acids are distributed among the six other specimens in the table with no indication of quantitative comparability between or among individuals.

DISCUSSION

The amount of variation in the free amino acids of the blood of individuals of a single species and of the same sex, age and diet is striking when large numbers of individuals are sampled. The magnitude of this variation in the population of *P. americana* sampled here may be due to the differential utilization of amino acids from the bloodstream, or differences in physiological activity which cannot be determined by chronological means. While the population used for these studies cannot be considered to be isogenic, it has been propagated free of outbreeding for a least three years.

Thus the variation in free amino acids of the blood, when diet and age are removed as possible contributors, can only be attributed to intrinsic genetic variability in the organism.

Any technique that is to be considered of practical value to taxonomy must be simple, precise, and reproducible. It must offer at least one or more qualitative differences between and among species that are immediately recognizable at the individual level, so that a single specimen can be accurately distinguished from one or more specimens of an allied or unrelated species. In this study on three species of *Periplaneta* we could not detect any qualitative differences in amino acids among the three species, and the quantitative values for the free amino acids exhibited such variation as to preclude the use of this technique in species separation. The technique, in short, lacked the simplicity, precision and, most obviously, the reproducibility necessary in systematic procedure.

It is conceivable that free amino acid analysis of some species may yield qualitative and quantitative data indicative of species specificity; however, there is no assurance of the general taxonomic applicability of this technique.

SUMMARY

Comparative studies of the intrapopulation variability of twelve amino acids were conducted on 100 specimens of the American roach, *Periplaneta americana*, of the same sex and age, and subjected to the same diet. Densitometric values for each of the amino acids varied greatly, from nearly sixfold for alanine, fivefold for cystine, and fourfold for methionine and valine, to differences of lesser magnitude for the other amino acids evaluated.

Comparative evaluation of the amino acids from several individuals of this species indicates that the concentration of each amino group acts semi-independently of all others.

Triplicate sample analyses of the blood of the species *P. australasiae* and *P. brunnea* resulted in average densities of all twelve amino acids that fell within the limits of variation found in the 100 specimens of *P. americana*. It is concluded that free amino acid analysis of some species may yield quantitative and qualitative data indicative of species specificity; however, there is no assurance of the general applicability of this technique.

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A DISTRIBUTIONAL CHEK-LIST OF NEBRASKA MOSQUITOES

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In 1944, Tate and Gates published the first comprehensive work on the mosquitoes of Nebraska. Their publication was based on specimens in the collection at the Entomology Department, University of Nebraska, and on specimens collected in light traps during the summers of 1942 and 1943. Since that time our knowledge of Nebraska mosquitoes has increased materially. During World War II the United States Public Health Service through its Division of Malaria Control in War Areas conducted many surveys around army posts, air fields, and prisoner of war camps. In addition the U.S. Army maintained the Seventh Service Command Medical Laboratory at Fort Omaha, and this organization conducted mosquito surveys on military bases in Nebraska. Olson and Keegan (1944 a, b) summarized the results of the Army's mosquito surveillance program in Nebraska. Following the war, the United States Public Health Service conducted surveys in many areas of Nebraska, where water resource development projects were proposed, and, during 1952 and 1953, maintained a field station at Mitchell to study mosquito production in irrigated areas. Since 1952, the Nebraska State Department of Health has conducted mosquito surveys throughout the state. This paper represents a summary of present knowledge of the Nebraska mosquito fauna.

ZOOGEOGRAPHY OF NEBRASKA

Nebraska's location in the center of a large continental land mass presents many perplexing problems in mosquito distribution. Although close to 90 per cent of the state lies in the grassland biome, there are many different ecological areas in the state. The western edge of the eastern deciduous forest biome is found along the Missouri River, for a short distance up the Platte River, and in the valleys of the Blue River, Elkhorn River and Loup River systems. Much of the deciduous forest in Nebraska represents an ecotone, often referred to as "oak parkland," a meeting of the true deciduous forest of the east and the grasslands of the west. The eastern portion, west of the deciduous forest is composed of the tall grass prairie; the central area is known as the mixed prairie; and the western part, the short grass prairie. The Sand Hill region is a distinct community in the short grass prairie region and is distinguished by rolling sandhills, numerous lakes, and marshes. In extreme northwestern Nebraska there is an eastern extension of the western coniferous forest biome. In the Pine Ridge areas of Sioux, Dawes, and Sheridan Counties there are large stands of ponderosa pine.

In May, 1955, the U.S. Department of the Interior, Fish and Wildlife Service at Billings, Montana, issued a publication entitled: "Wetlands Inventory of Nebraska." In this work they defined "wetlands" as: "Those

lands which contain too much soil moisture or are flooded too long during the growing season to permit their intensive use for the production of agricultural crops unless reclaimed by drainage, flood control, or other means." These areas represent the natural mosquito breeding areas of Nebraska. Approximately 652,000 acres of the state are considered to be wetlands. They are classified as 98 per cent fresh water and two per cent saline. The three principal wetland areas are (1) The Sand Hills, containing 640,000 acres, (2) The "rainwater basins" of Clay and Fillmore Counties, approximately 3,000 acres, and the North Platte Irrigation Project containing about 9,500 acres. Thus it can be seen that in spite of the fact that Nebraska is considered to be a dry land area there are large natural areas for mosquito production.

NEBRASKA MOSQUITOES

Anopheles Meigen

Anopheles (Anopheles) barberi Coquillett

This tree hole breeder is rare in Nebraska. It has been taken in very small numbers in Furnas, Hamilton, Nuckolls, Richardson and Saline Counties. Its distribution in Nebraska is limited because of its highly specific ecological niche.

Anopheles (Anopheles) earlei Vargas

In earlier publications Nebraska specimens of this species were called *A. occidentalis*. This species has only been taken at Glen, Sioux County.

Anopheles (Anopheles) pseudopunctipennis franciscanus McCracken

This species has been taken only in Franklin and Webster Counties. However, further field work may prove that it is widespread in the southern part of the state.

Anopheles (Anopheles) punctipennis (Say)

This species is widely distributed in the state. It is most abundant in the Missouri Valley region and decreases in numbers toward the western part of the state.

Anopheles (Anopheles) quadrimaculatus Say

At times, this species in eastern Nebraska reaches population densities large enough to become a severe biter. However, since malaria is not endemic in Nebraska it does not become a public health problem. Its range in Nebraska is limited to the Missouri River valley and to the southern part of the state.

Anopheles (Anopheles) walkeri Theobald

This species has been taken in all areas of the state in very small numbers.

Uranotaenia Lynch Arribálzaga

Uranotaenia sapphirina (Osten Sacken)

This species which seldom attacks humans, is distributed in very small numbers throughout the state. It is most numerous in eastern Nebraska and becomes rare in the western part of the state.

Culiseta Felt

Culiseta (Culiseta) impatiens (Walker)

This widely distributed species has been taken three times in Nebraska, twice in Lancaster County and once in Thurston County.

Culiseta (Culiseta) inornata (Williston)

This species is found throughout Nebraska. It is seldom found in large numbers but at times reaches sufficiently large populations that it will attack man (Rapp, 1954).

Culiseta (Culiseta) incidens (Thomson)

There are two records for this species in the state.

Culiseta (Climacura) melanura (Coquillett)

Olson and Keegan (1944a) report specimens collected at Fort Robinson, Dawes County, on August 11 and 19, 1944.

Orthopodomyia Theobald

Orthopodomyia signifera (Coquillett)

This tree hole breeder has been taken in the following eastern counties: Burt, Cass, Dodge, Otoe, and Saline.

Mansonia Blanchard

Mansonia (Coquillettidia) perturbans (Walker)

Two females have been taken, one at Valentine and one at Oshkosh.

Psorophora Robineau-Desvoidy

Psorophora (Psorophora) ciliata (Fabricius)

This species is found in small numbers in the eastern half of Nebraska as far west as Furnas County.

Psorophora (Psorophora) howardii Coquillett

Keener (1951) took this species along the Republican River in Nuckolls County.

Psorophora (Janthinosoma) cyanescens (Coquillett)

This species was taken by Keener (1951) in the Republican River valley in Nuckolls County.

Psorophora (Janthinosoma) ferox (Humboldt)

This species has been taken in Dawes, Frontier, Furnas, Otoe, and Richardson Counties.

Psorophora (Janthinosoma) horrida (Dyar and Knab)

This species has been taken in the following counties: Douglas, Frontier, Nuckolls, and Richardson.

Psorophora (Grabhamia) confinnis (Lynch Arribálzaga)

This species is widely distributed in the state but is most abundant in southeastern Nebraska.

Psorophora (Grabhamia) discolor Coquillett

This species has been taken in northwestern Nebraska, in the Missouri River valley and in a few interior counties.

Psorophora (Grabhamia) signipennis (Coquillett)

This is the common *Psorophora* found throughout the state.

Aedes Meigen

Aedes (Ochlerotatus) campestris Dyar and Knab

This species has been taken in the following counties: Kimball, Knox, Morrill, Phelps, Sheridan, Thurston, and Valley.

Aedes (Ochlerotatus) canadensis canadensis Theobald

This species has been taken only in Lancaster County.

Aedes (Ochlerotatus) dorsalis (Meigen)

This is a common species found throughout the state.

Aedes (Ochlerotatus) fitchii (Felt and Young)

This species was taken by light trap at Fort Robinson, Dawes County, on May 20 and June 24, 1944 (Olson and Keegan, 1944b).

Aedes (Ochlerotatus) flavescens (Müller)

This species has been taken in small numbers throughout the state.

Aedes (Ochlerotatus) idahoensis (Theobald)

This early spring species has been taken at Glen, Sioux County (Tate and Gates 1944). Since it is on the wing in April and May it possibly may be more abundant then supposed.

Aedes (Ochlerotatus) impiger (Walker)

Tate and Gates (1944) took this species in July and August, 1943, at Scottsbluff.

Aedes (Ochlerotatus) nigromaculis (Ludlow)

This common species is widely distributed throughout the state. It is often an abundant pest especially in irrigated areas.

Aedes (Ochlerotatus) sollicitans (Walker)

This brackish water species has been reported by Olson and Keegan (1944b) from Lincoln, Lancaster County, July 7, 1933, and Fort Omaha, Douglas County, June 5, July 7, 9, 10, and August 2 and 7, 1942.

Aedes (Ochlerotatus) spencerii (Theobald)

This early spring species has been taken in the following counties: Knox, Red Willow, Thurston, and Valley.

Aedes (Ochlerotatus) sticticus (Meigen)

This species has been taken in many areas in the state but is always taken in very small numbers. The majority of records are from the Missouri valley region (Rapp, 1958).

Aedes (Ochlerotatus) stimulans (Walker)

Tate and Gates (1944) report this species from Glen, Sioux, Pine Ridge, and Dawes County. This is an early spring species and may be more common than the records indicate.

Aedes (Ochlerotatus) trivittatus (Coquillett)

This is a common, widely distributed species. It seems to be limited to wooded areas along streams throughout the state.

Aedes (Finlaya) triseriatus (Say)

This tree hole breeder is found in small numbers throughout the state.

Aedes (Aedimorphus) vexans (Meigen)

All studies to date show that this is the most abundant species in Nebraska and that it is found in all parts of the state.

Aedes (Aedes) cinereus Meigen

This is a rare species in Nebraska having been taken in only the following counties: Morrill, Phelps, Valley and Washington.

Culex Linnaeus

Culex (Culex) pipiens Linnaeus

This common species is widely distributed throughout the state. The largest populations are found in the Missouri valley region (Rapp 1958) and diminish toward the western part of the state (Edmunds 1958).

Culex (Culex) quinquefasciatus Say

Tate and Gates (1944) report taking one male at Lincoln, Lancaster County.

Culex (Culex) restuans Theobald

This species is widely distributed throughout the state but is never taken in large numbers.

Culex (Culex) salinarius Coquillett

This is a very common species found throughout the state. At times it becomes a serious pest of man.

Culex (Culex) tarsalis Coquillett

This species is found in all areas of the state. The populations become increasingly larger toward the western part of the state (Rapp, 1955). This is the second commonest species in the state and is the principal mosquito of public health importance in the state.

Culex (Melanoconion) erraticus (Dyar and Knab)

This species reaches its northwestern limit in Nebraska. It has been taken in small numbers only in the eastern half of the state.

Culex (Neoculex) territans Walker

This species has been taken in small numbers throughout the state.

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NEW RECORDS FOR *RHINONYSSUS HIMANTOPUS* AND NOTES ON OTHER SPECIES OF THE GENUS[1]

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The genus *Rhinonyssus* has been characterized by Strandtmann (1956) as mites that have a single dorsal plate, no peritreme, no modified forked seta on palpal tarsus, no tritosternum, no deutosternal teeth, anal plate reduced or lacking, sternal plate greatly reduced or lacking, and that parasitize only water birds. This characterization is in my opinion still quite accurate in spite of the fact that Fain (1957) recently has added to the genus a species, *R. apus,* recovered from a micropodiform bird. According to Dr. Fain's description and illustration, his *Rhinonyssus apus* has a circular peritreme, an opisthosmal shield, and a strongly developed sternal plate. Also *R. apus* has a pair of setae on the epigynial plate. These are lacking in species of *Rhinonyssus* from water birds. These characteristics indicate to us that *R. apus* is improperly placed in the genus *Rhinonyssus.* Proper generic assignment without a study of the types probably should not be attempted, but I would nevertheless like to suggest that the genus *Neonyssus,* as presently defined, would be the proper place for the species.

The nine species of *Rhinonyssus* (excluding *R. apus* Fain) can be separated into three rather clearly defined groups.

Group A. Body elongated, no sternal plate, no anal plate; one dorsal plate which may be incomplete. Includes: *R. caledonicus, R. waterstoni,* and *R. coniventris.*

Group B. Body relatively short, rounded, oval or obovate; well developed dorsal plate; sternal plate present but nearly always considerably eroded; anal pore apical or dorsal, no anal plate; tarsal claws I prominently angulate; three prominent setae at apex of pedipalp (two at apex of tibia, one on tarsus). Includes: *R. himantopus, R. minutus, R. afribyx.*

Group C. Body rounded or obovate, dorsal plate well developed or partly eroded; no sternal plate but with an anal plate; pedipalps with several heavy, spur-like setae. Includes: *R. rhinolethrum, R. poliocephali,* and *R. alberti.*

The species may be separated as follows:

Group A.

1. Dorsal plate strongly eroded, frequently reduced to platelets; pedipalps

[1] Supported by Research Grant E-616 from the National Institutes of Health.

with several long, flexible setae dorsally on apical segments; three pairs of sternal setae, the third pair only appendiculate; empodium of tarsus I clawlike. Large mites, up to 2 mm. long — *coniventris* Trouessart, 1894
Not as above. 2

2. Dorsal plate only slightly, if at all, eroded; pedipalps with two heavy and one slender seta apically, no long, flexible setae; two or three pairs of attenuated sternal setae; no clawlike empodium; tarsal claws I each with a dorsal tubercle at the bend; only 4 ventral setae on opisthosoma. Large mites, 1.5 mm. ..... *caledonicus* Hirst, 1921
Dorsal plate not known; sternal setae mere spinulets; more than 4 ventral opisthosomal setae. About 1 mm. long. ..... *waterstoni* Hirst, 1921

Group B.

1. Dorsal plate truncate or broadly rounded posteriorly. Female about 800 μ, the male about 700. ..... *himantopus* Strandtmann, 1951
Dorsal plate acutely produced posteriorly 2

2. Epigynial plate as broad or broader than long, the posterior margin truncate or nearly so. Female about 830 μ ..... *afribyx* Fain, 1956
Epigynial plate decidedly longer than broad; its posterior margin clearly rounded. Female about 750 μ ..... *minutus* (Bregetova), 1950

Group C.

1. Anal plate twice as long as wide, all of the plate lies posterior to the pore and is longitudinally striated, cribrum well developed; anal setae long, hair-like; ventral setae slightly inflated basally and clearly attenuated. From 900 to 1500 μ ..... *rhinolethrum* (Trouessart), 1895
Anal plate round or nearly so, not longitudinally striated, no cribum; plate surrounds the pore, or nearly so 2

2. Posterior margin of dorsal plate sharply extended medially; ventral setae short, broad, broadly rounded at tip. About 820 μ ..... *alberti* Strandtmann, 1956
Dorsal plate severely eroded posteriorly; ventral setae short, heavy, acutely pointed. About 875 μ ..... *poliocephali* Fain, 1956

Rhinonyssus himantopus

Two new host records of interest are here reported. One is from the avocet, *Recurvirostra americana*. Two birds yielded 16 mites, 3 ♂, 11 ♀, 2 N, which agree in every respect with those from the type host, *Himantopus mexicanus*. This is as it should be, the two hosts are closely related, belonging to the same family, Recurvirostridae.

The second record is more surprising. It is from the plover known commonly as the Killdeer, *Charadrius vociferus*. This bird is more closely related to those plovers that commonly harbor *R. coniventris* than it is to the Recurvirostridae. However, it is quite distinct ecologically from its near allies. Whereas most plovers frequent wet or marshy habitats, the killdeer is distinctly an inland, dry land bird. The rate of parasitism is very low. We have examined some 20 birds and found only 2 birds infested, for a total of 8 mites (2 ♂, 4 ♀ 2 N).

The mites are strikingly similar to the mite from the Recurvirostridae

and it is here considered as being the same species, *R. himantopus*. However, there are subtle differences, which, if they prove to be constant on more specimens, may eventually justify regarding it as a separate species. The killdeer mite is illustrated to emphasize both the differences and the similarities to *himantopus*. One immediate difference is size. The females of the killdeer mite measure only 600 μ to 650 μ; those from the stilt and avocet average 800 μ. The posterior margin of the podosomal plate of the

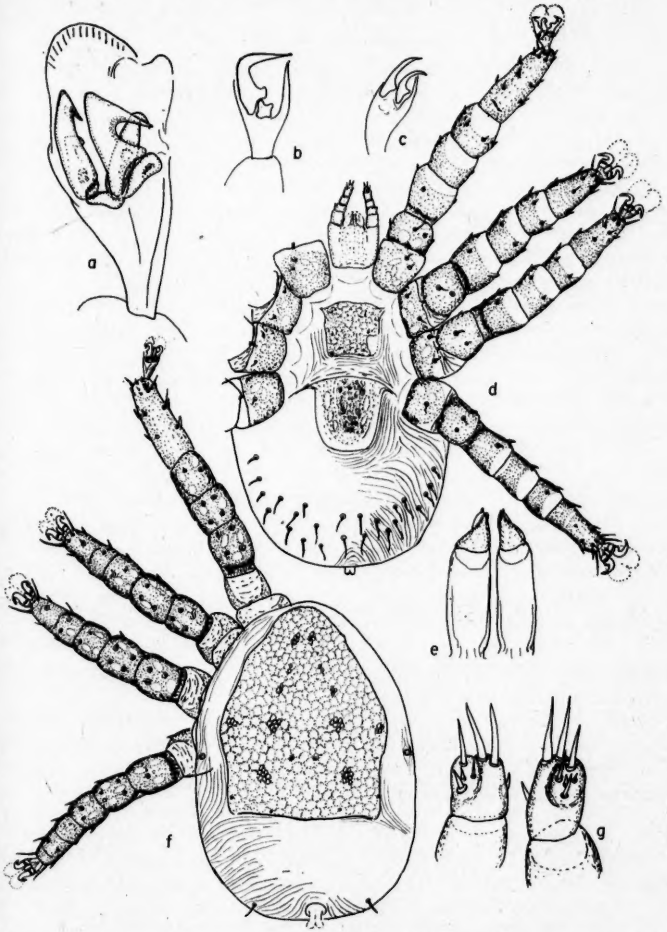

Fig. 1. *Rhinonyssus himantopus, ex* killdeer a. ambulacral apparatus, tarsus I, female; b. claws of tarsus II, larva; c. claws of tarsus I, larva; d. female venter; e. chelicerae of female; f. female dorsum; g. ventral view, pedipalpal tibia and tarsus of female.

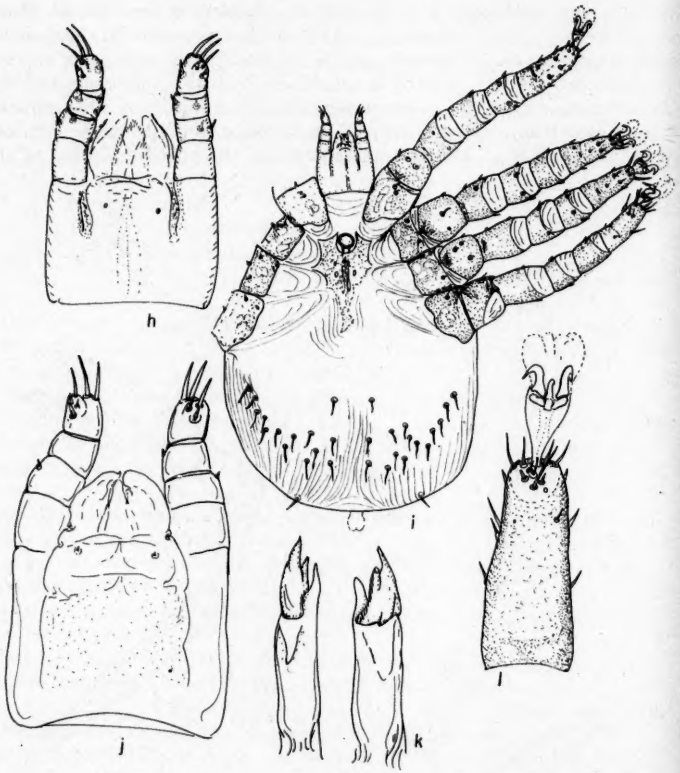

Fig. 2. *Rhinonyssus himantopus, ex* killdeer. h. ventral view male gnathosoma; i. male venter; j. female gnathosoma; k. male chelicerae, l. tarsus I of male.

killdeer mites is clearly truncate or mildly biconcave. In the stilt and avocet mites the posterior margin is convex.

Fain (1957) has recovered *R. himantopus* from *Charadrius tricollaris,* a near relative of the killdeer, and kindly sent me a specimen for my collection. Interestingly enough, this mite is also small and has the biconcave posterior margin as does the killdeer mite.

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DISCUSSION OF SYNONYMY AND FIRST ILLUSTRATIONS OF LARVA AND PUPA OF *COREOPSOMELA ELEGANS* (OLIVIER 1807) FROM CALIFORNIA

(Notes on North American Coleoptera, No. 6)

Charles S. Papp[1]

I. *Synonymical Remarks*

In 1945 Brown introduced a new name, *Calligrapha californica coreopsivora,* for *Chrysomela elegans* Olivier 1807, "not Gmelin, 1789."[2] In the same paper (Canad. Ent., 77, 1945:117-133) Brown also synonymized, under this new name, *Zygogramma virgata* Gemminger & Harold 1874, not Stål 1859. The same chain of synonymy was taken over automatically by Blackwelder in the Fifth Supplement to the Leng Catalogue of Coleoptera (1948:42), as the existing status at that time. This arrangement of synonymy seems confusing. According to the old "Catalogus Coleopterorum," compiled and edited by Gemminger & Harold in Munich, 1874, Volume XI (which is the first part of the family Chrysomelidae), the authors did not mention *Zygogramma virgata* G. & H. but did list *Z. virgata* Stål which is a species from Brazil, not from North America, and which was described by Stål in his "Bidrag till kännedomen om Amerikas chrysomeliner," published in 1859 in the Öfv. Svenska Vetenskampsakademien Förhendlingen, Vol. 16, pp. 305-326, with *virgata* on page 318. Later, in 1865, Stål redescribed his *virgata* in a monographic study, "Monographie des Chrysomèlides de l'Amerique," in Nova Soc. Sci. Upsaliensis, Series 3, Vol. 5, p. 175-365, with *virgata* on page 233.

In 1807 Olivier (not Oliver) described *elegans* (in Entomologie, ou histoire naturelle . . ., Paris, Vol. V, p. 532, pl. 6, f. 92) from North America. Suffrian (Stettiner Entom. Zeitung, 1858:276-277) stated that ". . . übrigens ist die von diesem Schriftsteller /e.g. Olivier/ gegebene Beschreibung sehr treffend." He found some specimens in the material of the Germar collection with heavier punctation on the prothorax, but he left these specimens unnamed and noted only that they are commonly found with other specimens from the same location. Suffrian recorded distribution in the central and southern states and noted that all the specimens of *elegans* Oliv. passed through the hands of Say, Hentz and Germar. In a random note Suffrian also mentioned *"Chrysomela virgata* Knoch" in the collection of the Berlin Museum and noted that this *virgata* supposedly came from Melsheimer. This is possibly the point where the confusion in the synonymy started. Gemminger and Harold in the "Catalogus," p. 3435, mentioned this species name as a synonym to *elegans* Oliv., which seems not to have been recognized by Melsheimer, who distributed to European collections the real *elegans* Oliv. labelled with the name *virgata*

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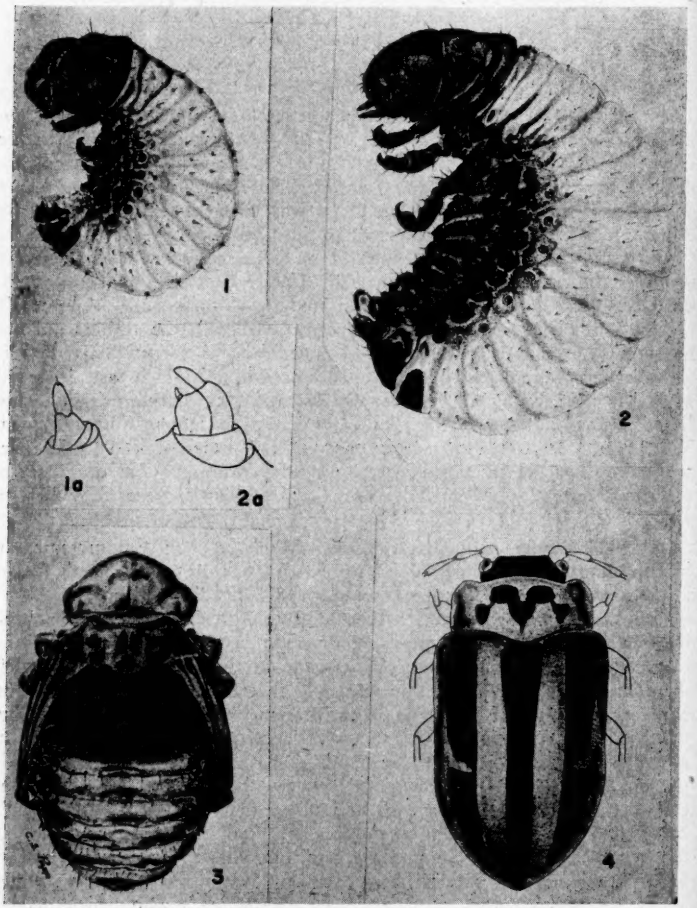
[2] This must be a mistake, for there are no indications that Gmelin described such a beetle.

Knoch. Earlier (1865), Stål also mentioned *elegans* Oliv. as a valid species in his "Monographie," p. 259.

Fall (1901) mentioned *Calligrapha elegans* v. *californica* Linell (see Part II of this paper). In 1920 Leng listed in his Catalogue (No. 15669a) *californica* Linell (1896, Journ. N. Y. Ent. Soc., p. 198) as a variety (or

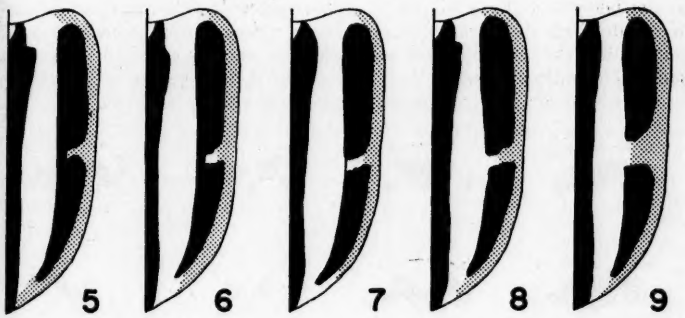


Figs. 1 to 4. Life History of *Coreopsomela elegans* (Olivier). Fig. 1, young larva; 1a, antennae of young larva; 2, full grown larva (the head, prothorax, legs and body beneath are black; the remainder of the segments are pink in color in both young and full grown larvae); 2a, antenna of full grown larva; 3, pupa (pale yellowish, almost white, the heavily darkened area shiny black); 4, adult (the ground color yellow, markings black; the edges of elytra pinkish in life).

synonym ?) of *elegans* (Oliv.). Until 1945 this species was known as *Calligrapha elegans* (Olivier); then Brown (op. cit.) changed it to *Calligrapha californica coreopsivora,* giving credit to Linells' name (1896) and synonymizing *elegans* (Oliv. 1807) with the new subspecies *coreopsivora* Brown.

Later, in 1955, Monrós established a new genus, *Coreopsomela* (Coleopt. Bull., 9:55), and for synonymical status he followed the citation of the Zoological Record (Vol. 82, section 13, p. 244), taking over the existing synonymy and selecting *californica* Linell as the type species.

If we thoroughly analyze the above chain of synonymy, we can see that no one corrected the description of *elegans* Oliv. 1807 since it was introduced, because from the original description it is possible to recognize the



Figs. 5 to 9. Color variations of the elytra in specimens of *Coreopsomela elegans* from the Whittier Narrows, near Rosemead, California. The dotted part indicates the pinkish colored portion of the elytra of live specimen.

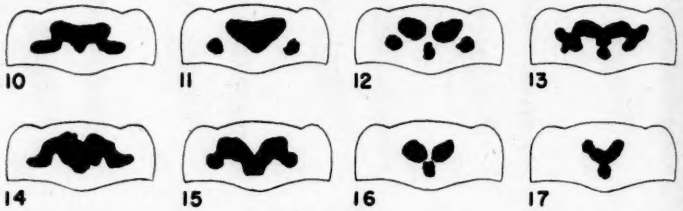
species. Leng (op. cit. p. 295) agreed that *elegans* (Oliv.) has priority over *californica* Linell, and Leng never hesitated to ask help from specialists if he was uncertain of synonymical status. In view of the facts stated above, the following arrangement of synonymy is recommended:

Coreopsomela elegans (Olivier 1807)
= *Calligrapha californica* Linell 1896
= *Calligrapha californica coreopsivora* Brown 1945
= *Coreopsomela californica* (Linell)
= *Coreopsomela californica coreopsivora* (Brown)
= *Zygogramma virgata* Knoch, not Stål
Zygogramma virgata Stål 1859, not Knoch; a species from South America

II. *Field Observations*

This species has not been recorded in southern California since 1901. Fall (Occasional Papers Calif. Acad. Sci., San Francisco, vol. 8, 1901, p. 155) mentioned that "*Calligrapha elegans* v. *californica* is a rare species in southern California; I have seen small series secured at Pomona and Pasadena, in June." In June 1956 Mr. Richard Watson collected three specimens in the Whittier Narrows, near Rosemead, Los Angeles County, on the leaves of *Bidens laevis.* As it was regarded as a "rare" species from this

territory, Mr. Robert H. Crândall took motion pictures of live specimens for distributional records (1956), and the film is kept in the Crandall Film Library. The following year Watson reported about 50 additional specimens collected between May and August on the same plant as before. This time considerable damage to the leaves by larvae and adults was noted. In 1958 this species was very common and caused a great deal of damage to the leaves of *Bidens*. In September 1958 it was observed that the damage to *Bidens* was so great only the very large, strong leaves could survive; all the softer and younger leaves were chewed and some of them were 90% destroyed. At the end of the same month Watson reported additional larvae and also two pupae. Pupation took place in the very wet soil, about one-quarter to one-half inch below the surface of the very coarse, gravelly soil in the bottom of the wash. A plant transplanted with the local soil and water and kept in Riverside provided five additional larvae and two more pupae; then the plant died, the soil was dried, and the entire plant with the soil was completely burned. It is interesting that no pupae were collected in dry soil in the field nor in the transplanted culture with dry soil.



Figs. 10 to 17. Variations of black markings on the prothorax of specimens of *Coreopsomela elegans* from the Whittier Narrows, California. The markings are not necessarily symmetrical.

Lack of facilities and time to complete and secure all stages with other important biological records forced discontinuance of observations, so this paper cannot summarize all the necessary dates of the life-cycle. In the summer of 1958 attention of Mr. Louie Blanc, Systematic Entomologist, California State Department of Agriculture, Sacramento, was called to this beetle, and several specimens were secured for him. With his help it was possible to obtain positive identification of specimens.

From leaves of *Bidens laevis* young and full-grown larvae were obtained, and pupae were collected from the soil. The accompanying illustrations were completed as a preliminary study to the life-cycle of this elegant beetle. It is also interesting to note that the food plant, *Bidens laevis,* on which this species is now found abundantly, has recently had an enormous outbreak in its distribution in the Whittier Narrows. Two years ago, according to Watson, only a very few of these plants were visible in the whole area, and today this one to five foot high composite has practically overgrown the entire area.

As an aid to collectors who may be interested in a study of the life-cycle of this beetle and who are having difficulties in identifying the food plant,

the following detailed information is given from Dr. W. L. Jepson's observations: *Bidens laevis* B.S.P., or *Bur Marigold,* is an annual (or in the South a perennial) plant. The stem is often decumbent at the base, 1 to 2, or even 5 feet high, glabrous; the leaves more or less connate at the base, 3 to 8 inches long; the outer involucre rather longer than the inner, the bracts often serrulate; rays oval, golden brown, ¾ to 1 inch long; disk brownish, heads in fruit erect or nodding; achenes flat or flattish, cuneate, distinctly carinate on the sides and retrorsely hispid on the marginal angles; awnes, 2 or 3. Low wet ground, marshes or river lowlands, 10 to 1200 feet. Coastal southern California, south coast ranges, San Joaquin and Sacramento Valleys, east to Massachusetts and Florida, south to Mexico. It blooms in the Narrows in September and October.

For the identification of the food plant, sincere thanks are expressed to Dr. L. C. Wheeler, University of Southern California, Los Angeles, and R. H. Crandall, Altadena, California.

Specimens of adults were distributed to the following collections and institutions: Department of Entomology, University of California, Riverside and Berkeley; California Academy of Sciences, San Francisco; Los Angeles County Museum; California State Department of Agriculture, Sacramento; The American Museum of Natural History; Smithsonian Institution; Museum of Comparative Zoölogy; Museum Georg Frey, München, Germany; Deutsches Entomologisches Institut, Berlin-Friedrichshagen, Germany; and the British Museum (Natural History), London, England.

The sudden outbreak of this leaf-feeding beetle shows that more information should be obtained about its life cycle. What may be just a harmless insect today could be an injurious garden pest tomorrow.

A NEW SPECIES OF *OZARKOGONA* FROM INDIANA (Diplopoda: Chordeumida: Cleidogonidae)

NELL B. CAUSEY
Fayetteville, Arkansas

Family Cleidogonidae

Cleidogonidae, Chamberlin and Hoffman, 1958, U.S. Nat. Mus., Bull. 212, p. 89, *cum synon.*

The posterior gonopods in the family Cleidogonidae are simple and markedly leglike. Although much less important than the anterior gonopods, they are useful in making generic, and sometimes specific, determinations. They show a family trend toward the reduction and loss of the distal segments and the enlargement of the proximal segments. The loss of the terminal claw is rare. Frequently simple lobes that lock the dorsal branchès of the anterior gonopods very securely into position are added to the first segment. In *Cavota,* the genus in which these gonopods most closely re-

semble walking legs, they are six-segmented, and the basal segments are not especially enlarged. In other genera, they are shorter, the basal segments are enlarged, and the number of segments is five, four, or three. The number may be constant for a genus or a species, or it may vary a segment or two.

Genus *Ozarkogona*

Ozarkogona Causey, 1951, Jour. Washington Acad. Sci., vol. 41, no. 2, pp. 80-81.

Type species: *Ozarkogona glebosa* Causey 1951. Other species: *Ozarkogona ladymani* Causey 1952 and *O. levis,* new species.

Range: Arkansas and Indiana.

Body brown with tan maculae on the dorsum, smooth, the metatergites bulging laterad slightly more than in *Cleidogona;* length 15 or 16 mm.; segmental setae as in *Cleidogona;* gnathochilarium with a distinct prementum; a short, rounded lobe on proximal region of third segment of leg pairs 10 and 11 of male. Ventral branch of anterior gonopod without a seminal canal, directed caudad; dorsal branch shorter, clavate, well separated from its mate at the base. Posterior gonopod composed of an elongated, massive basal segment with one or two large, ovoid lobes on its anterior surface; a shorter, smaller, elongated, cylindrical second segment that is indistinctly segmented distad; and a minute, rounded terminal segment that bears a claw. Between the posterior gonopods is a stout, cylindrical sternal process that appears to be homologous with cylindrical and clavate sternal processes in *Tiganogona* and *Ofcookogona,* and perhaps in *Rhabdarona.*

The close similarities between the gonopods of this genus and those of the little known, monotypic, Indiana[1] genus *Bactropus* are important, since *Bactropus* is the type genus of the family Bactropidae (Chamberlin and Hoffman, 1950). The posterior gonopods of *Bactropus conifer,* as drawn by the authors (Cook and Collins, 1895), resemble those of any species of *Ozarkogona,* except for the absence of the ovoid lobes on the basal segment; the anterior gonopods resemble those of *Ozarkogona glebosa* from which the dorsal branches have been broken, an accident that sometimes happens in the genera that have large lobes on the basal segment of the posterior gonopods. Cook and Collins found the mentum undivided in *B. conifer;* all species of *Ozarkogona,* as in the other genera of the Cleidogonidae, have the mentum divided horizontally.

Key to the Species of *Ozarkogona,* Based on the Male

1a. Apex of ventral branch of anterior gonopod narrowly attenuated and hamate ..... *glebosa*
1b. Apex of ventral branch of anterior gonopod rounded, not hamate 2
2a. Dorsal margin of ventral branch of anterior gonopod finely and evenly serrated ..... *ladymani*
2b. Dorsal margin of ventral branch of anterior gonopod membranous and fringed ..... *levis,* new species

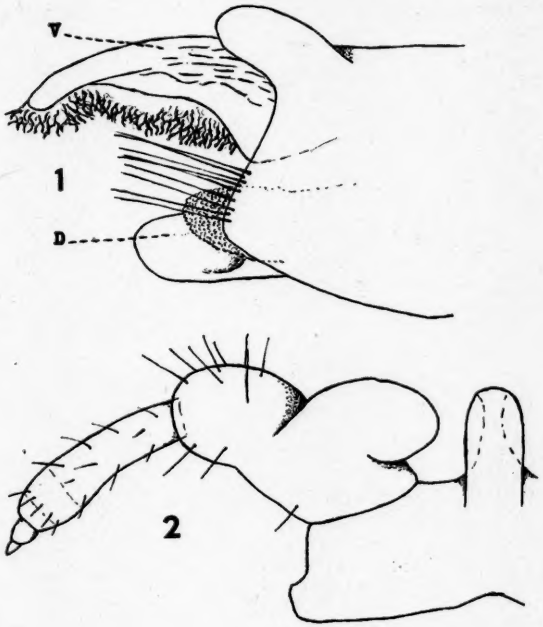
[1] The report of *Bactropus conifer* from Michigan (Bert M. Johnson, 1954, Michigan Acad. of Sci., Arts, and Letters, vol. 39, p. 242) was based on a single female collected at Douglas Lake, Cheboygan County (personal letter from Dr. Frank E. Eggleton). I have never seen this species.

Ozarkogona levis, new species

Figures 1 and 2

Diagnosis: Distinguished especially by the fringed, membranous dorsal margin of the ventral branch of the anterior gonopod.

Description of male holotype: Length about 15 mm., greatest width 1.7 mm. Color in alcohol dark brown above and tan below; metatergites brown, most of them with a transverse series of four ovoid, tan colored maculae; protergites dark gray, each with two ovoid maculae that are in



Ozarkogona levis, new species. Fig. 1. Left anterior gonopod, lateral view. V, ventral branch; D, dorsal branch. Fig. 2. Left posterior gonopod, anterior view. The figures are drawn to the same scale.

line with the lateral maculae on the metatergites. Gnathochilarium with a triangular promentum. Ocelli 24 and 23, arranged in series of 1, 5 (6), 6, 5, 4, 2. Articles of antennae with the following ratio, beginning at the apex: 7, 8, 21, 14, 27, 10, 2. Metatergites bulging slightly below segmental setae, which are short, acute, and arranged as usual in the family. Each coxa of leg pairs 10 and 11 with the usual gland and a cylindrical plug protruding from it; third segment of these legs with a short cylindrical lobe on the proximal half of the mesial surface.

In situ the ventral branches of the anterior gonopods curve caudad, reaching the coxae of the eleventh legs; the dorsal branches are held firmly between the lobes and the sternal peg of the posterior gonopods. The lateral view (Fig. 1) shows both branches of the left anterior gonopod; the membranous fringed margin of the ventral branch and the scabrous lobe on the dorsal branch are especially distinctive. The posterior gonopod (Fig. 2) has the usual medial, cylindrical sternal peg; the large lobe on the anterior surface of the first segment is simpler than in *O. glebosa* and *O. ladymani;* the elongated telopodite consists of four indistinct segments and a terminal claw.

Type locality: Richland Creek, Greene County, Indiana, March 25, 1952, collected by B. G. Owen.

Type material: One male, in the American Museum of Natural History, New York.

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